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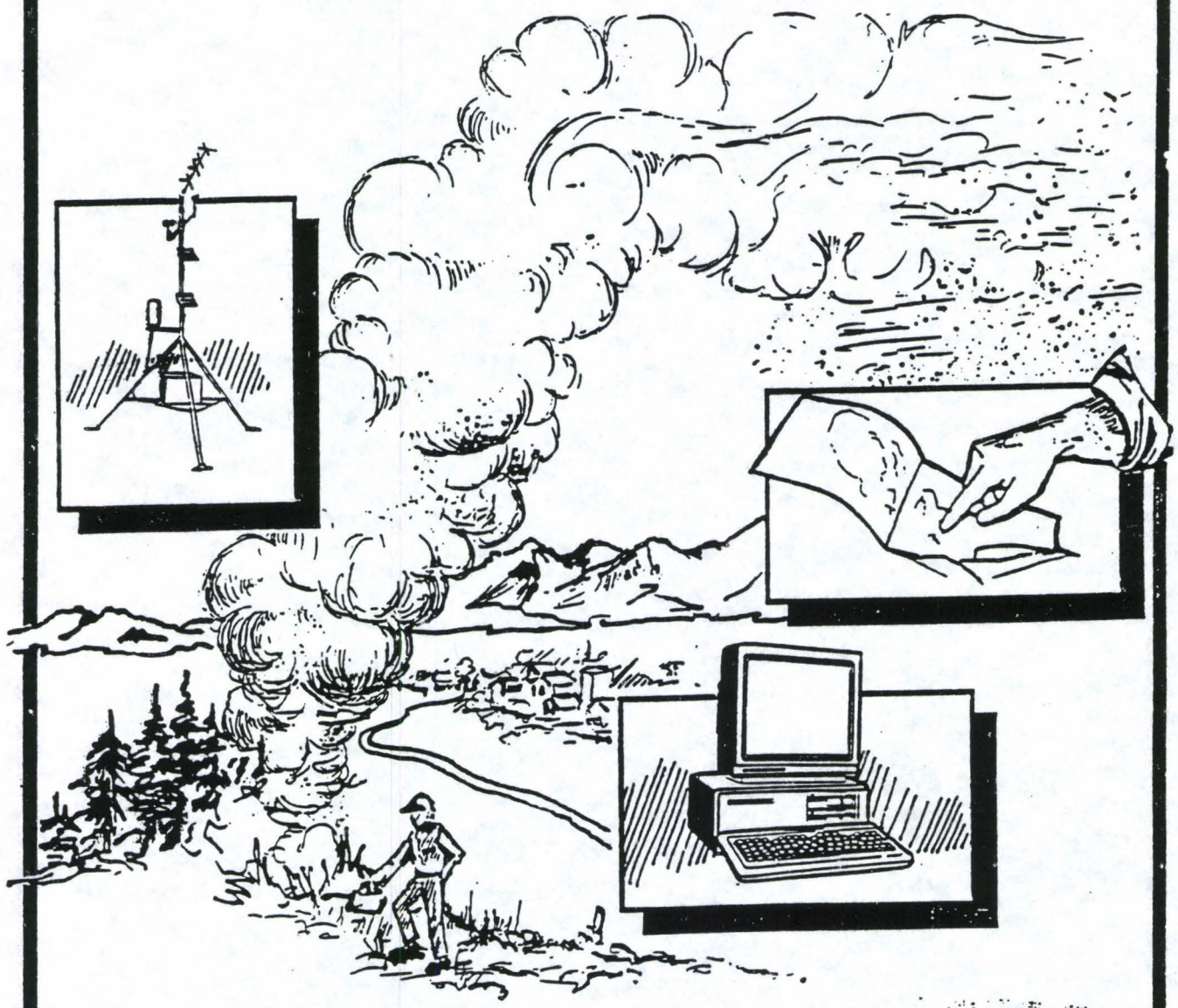
Smoke Management



USDA
Forest
Service
R-4

FMO Guidance Document
3-16-98 Workshop - FAA
CRB/ARM

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NEPA AIR QUALITY ANALYSES

USDA Forest Service

Prepared by CH2M HILL

MARCH 1995

3.1.1 Wildfire and Prescribed Natural Fire

From USFS
NEPA Air
Quality Desk
Guide March 1995

3.1.1 Wildfires and Prescribed Natural Fire

Source of Emissions Data

The following information was obtained from:

Peterson, Janice L. *Guidelines for Preparing a NEPA Air Quality Analysis.* (personal communication).

U.S. Environmental Protection Agency. 1985 and ff. *Compilation of Air Pollutant Emission Factors, Volume I: Stationary Point and Area Sources* (Fourth Edition). Section 11.1.

Estimating Emissions

General Description.[1] Wildfires, including prescribed natural fires, are a natural combustion process that consumes various ages, sizes, and types of flora growing outdoors in a geographical area. Wildfires are a potential source of large amounts of air pollutants.

The size, intensity, and occurrence of a wildfire depend directly on variables such as meteorological conditions, the species of vegetation involved and their moisture content, and the weight of consumable fuel per acre (available fuel loading). In the beginning stages of a wildfire, the dry combustible material is consumed first. As the wildfire progresses, the drying of green, live material occurs, with subsequent burning of this material as well. Under proper environmental and fuel conditions, this process may initiate a chain reaction that results in a widespread conflagration.

The complete combustion of wildland fuels (e.g., forests, grasslands, wetlands) requires a heat flux (i.e., temperature gradient), adequate oxygen supply, and sufficient burning time. The size and quantity of wildland fuels, meteorological conditions, and topographic features interact to modify the burning behavior as the fire spreads, and the wildfire will attain different degrees of combustion efficiency during its lifetime.

Fuel Loading Data[1]. Estimates of wildfire emissions requires detailed information on the *available* fuel loading; that is, the amount of combustible material consumed by wildfire under specific weather conditions. This should not be confused with either *total* fuel loading (that is, all the combustible material that would burn under the most severe weather and burning conditions) or *potential* fuel loading (that is, the larger woody material that remains even after a high-intensity wildfire).

Available fuel loadings may be estimated in one of several ways:

- Use of fuels inventory data when available (or alternatively, the National Fire Danger Rating System fuel model profiles) coupled with experience-based estimates of the percentage fuel consumption under specific fuel moisture and weather conditions.

- Use of fuels inventory data (or alternatively, the National Fire Danger Rating System fuel model profiles) coupled with model estimates of fuel consumption under specific fuel moisture and weather conditions. Available models include the First Order Fire Effects Model (FOFEM) and the CONSUME model[2].

- Use of historical wildfire fuel consumption data for different Forest Service regions. These estimates are presented in Table 3.1.1-1. Caution should be exercised in the use of these data; they are based on 1971 estimates of fuel consumption only, and should probably be used only if local fuel loading data are unavailable.

Table 3.1.1-1
Regional Estimates of Available Fuel Loading[a]

Forest Service Region	Available Fuel Loading	
	(tons/acre)	(Mg/hectare)[b]
Region 1 - Northern	60	135
Region 2 - Rocky Mountain	30	67
Region 3 - Southwestern	10	22
Region 4 - Intermountain	18	40
Region 5 - California	18	40
Region 6 - Pacific Northwest	60	135
Region 8 - Southern	9	20
Region 9 - Eastern	11	25
Region 10 - Alaska	16	36
All Regions	17	38

[a] Source: USEPA (1985), AP-42, 1971 fuel consumption only
[b] Fuel loading consumed in wildfire per unit area
[c] Mg = megagram (one million grams)

Emission Factor Data.[1] It has been hypothesized, but not proven, that the emission factors for wildfire (i.e., the mass of pollutants emitted per unit mass of fuel consumed) are directly proportional to the intensity and direction of the wildfire (relative to the wind), and indirectly proportional to the rate of fire spread. Logistical problems (such as size of the burning area) and difficulties in safely situating personnel and equipment close to the fire has limited the collection of reliable emissions data from wildfires.

The only published data on wildfire emission factors was based on laboratory burning experiments. These data are presented in Table 3.1.1-2 and -3. These emission factors are not vegetation or regionally specific, and appear to be based primarily on flaming combustion (as a opposed to smoldering combustion). Because these data are based on laboratory scale combustion experiments, substantial errors may result if they are used to calculate actual wildfire emissions.

Darold Ward of the USDA Forest Service Intermountain Fire Research Laboratory in Missoula, Montana (406/329-4866) has compiled some wildfire emission factor data for some western forest types. These estimates are based on direct sampling of air in the vicinity of wildfires coupled with estimates of fuel consumption.

Table 3.1.1-2
Emission Factors By Forest Service Region (English Units)a

Forest Service Region	Emission Factors (lbs/ton)			
	Total PM	CO	VOC[b]	NO_x
All Regions	16.5	140	24	4

[a] Source: USEPA (1985), AP-42
[b] As methane

Table 3.1.1-3
Emission Factors By Forest Service Region (Metric Units)a

Forest Service Region	Emission Factors (kg/Mg)			
	Total PM	CO	VOC[b]	NO_x
All Regions	8.5	70	12	2

[a] Source: USEPA (1985), AP-42
[b] As methane

Emission Calculations. The total pollutant emissions for wildfire are calculated using the following equation:

$$E = EF * L * A$$

where
- E = Total emissions of pollutant (pollutant mass; tons)
- EF = Emission factor of pollutant (mass of pollutant emitted per mass of forest fuel consumed; lbs/ton)
- L = Fuel consumed (mass of fuel consumed per unit area of land burned; tons/acre)
- A = Land area burned (acres)

Example

A wildfire in the Pacific Northwest burns 24,710 acres and consumes an average of 60 tons of woody fuel per acre. The total estimated particulate matter emissions from this wildfire are:

$$E = \left(16.5 \frac{lbs\ PM}{ton\ fuel}\right) \cdot \left(60 \frac{ton\ fuel}{acre}\right) \cdot (24{,}710\ acres) \cdot \left(\frac{1\ ton}{2{,}000\ lbs}\right)$$

$$= 12{,}231\ tons\ PM\ emitted$$

Hazardous Air Pollutants, Trace Elements, and Ozone. Wildfires emit large amounts of volatile organic compounds (VOCs) and nitrogen oxides, both precursors of the photochemical oxidant ozone. In remote parts of the United States, the formation of ozone is limited primarily by the availability of NO_x; vegetation is a significant source of naturally occurring VOCs. In these "NO_x-limited environments," the addition of relatively small amounts of NO_x could (under the right weather conditions) lead to the formation of large amounts of ozone.

Ozone is usually not found in the vicinity of fires, but it has been shown to form by photochemical reaction in the tops of plumes[3]. Formation of ozone appears to be limited by penetration of light into the plume; as the plume becomes less dense, ozone concentrations become greater relative to smoke density. Consequently, a fire may contribute a significant fraction to the total ozone load at downwind locations. If the plume comes to ground, it may carry photochemically formed ozone with it. Because ozone is a significant pulmonary and vegetation oxidant, the likelihood that this event would result in high concentrations of

ground-level ozone should be considered in the NEPA air quality analysis. Such an analysis would require detailed information on the ozone concentrations at the tops of plumes, the plume dimensions and height, and the meteorological conditions in the vicinity of the fire (e.g., wind speed, atmospheric stability, mixing heights). This information could then be used in a simple Gaussian dispersion modeling analysis to show the ground-level concentrations downwind of the fire. A more refined modeling analysis would include the use of a regional photochemical model.

The most important potential for health effects from fires is from exposure to organic hydrocarbons. Several hundred compounds are emitted in smoke from wildland fires[3]. Two of the most important classes of compounds are polynuclear aromatic hydrocarbons (PAHs), and aldehydes.

PAHs are a well-known component of smoke, with some potential for causing cancer in exposured individuals. Examples of PAH compounds include benzo-c-phenanthrene, benzo-a-pyrene, and 3-methylcholanthrene. PAHs do not exist as free gases or vapor in the environment, but are adsorbed onto fine particles that are respirable. For wildland fires, the risk of cancer from PAH emissions is negligible[3].

Of the aldehydes produced in combustion, formaldehyde is the most extensively studied because of its wide use as a process chemical and as as component of adhesive resins. It is an irritant and is allergenic at low concentations. It is known to cause cancer in laboratory animals. Measurements of formaldehyde emissions from fire are not considered reliable, although order-of-magnitude estimates have been constructed from the scant data that exist. Between 1 and 7 grams of formaldehyde per kilogram of fuel consumed is reasonable, with accompanying estimates of 0.5-1 grams per kilogram of acetaldehyde, and 0.05-0.1 grams per kilogram of acrolein[3]. For conservatism, the upper end of each range should be used in any modeling analysis or risk assessment.

For more complete information on combustion products and emission estimates from wild and prescribed fire, the reader is encouraged to review Chapter 16 in *Natural and Prescribed Fire in the Pacific Northwest*[3].

Mitigation Techniques

The most effective means of controlling wildfire emissions is to prevent the occurrence of wildfires. A frequently used technique for reducing wildfire occurrence is "prescribed" or "hazard reduction" burning. This type of managed burn involves combustion of dead-and-down woody debris, litter, and some underbrush to prevent fuel buildup under controlled conditions, thus reducing the danger of a wildfire. Properly executed, controlled burning is expected to produce fewer total emissions than wildfire. The reasons for this include: (1) prescribed fires typically burn fewer acres than wildfires, (2) prescribed fires are managed under weather conditions that presents a small risk of crowning (i.e., burning through the

crowns), and (3) prescribed fires are set under carefully controlled conditions of high fuel moisture contents, which reduces the total consumption of large woody material and duff.

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3.1.2 Prescribed Burning

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Source of Emissions Data

The following information was obtained from:

Peterson, Janice L. *Guidelines for Preparing a NEPA Air Quality Analysis.* (personal communication)

U.S. Environmental Protection Agency. 1985 and ff. *Compilation of Air Pollutant Emission Factors, Volume I: Stationary Point and Area Sources* (Fourth Edition). Section 1.11.

Estimating Emissions

General Description.[1] Prescribed burning is a land treatment used under controlled conditions to accomplish natural resource management objectives. Prescribed fires are conducted within the limits of a fire plan and prescription that describes both the acceptable range of weather, moisture, fuel and fire behavior parameters and the ignition method to achieve the desired effects. Prescribed fire is a cost-effective and ecologically sound tool for forest, range, and wetland management. Its use reduces the potential for destructive wildfires and thus has the potential to maintain long-term air quality. Also, this practice removes logging residues, controls insects and disease, improves wildlife habitat and forage production, increases water yield, maintains natural succession of plant communities, and reduces the need for pesticides and herbicides. The major air pollutant concern is the smoke produced by prescribed fire.

Emission Factor Data.[2-13] Smoke from prescribed fires is a complex mixture of carbon, tars, liquids and different gases. This open combustion source produces particles of widely ranging size, depending to some extent on the rate of energy release of the fire. For example, total particulate matter and particulate matter less than 2.5 micrometers mean diameter by mass are produced in different proportions, depending on rates of heat release by the fire[2]. This difference is greatest for the highest intensity fires, where particle volume distribution is bimodal, with peaks near 0.3 micrometers and exceeding 10 micrometers[3]. Particles over about 10 microns, probably of ash and partially burned plant matter, are entrained by the turbulent nature of high-intensity fires.

In discussing prescribed burning, the combustion process is divided into preheating, flaming, glowing, and smoldering phases. The different phases of combustion greatly affect the amount of emissions produced[5-7]. The preheating phase seldom releases significant quantities of material to the atmosphere. Glowing combustion usually is associated with the burning of large concentrations of woody fuels such as logging residue piles. The smoldering combustion phase is a very inefficient and incomplete combustion process that emits pollutants at a much higher ratio to the quantity of fuel consumed than does the flaming combustion of similar materials.

The amount of fuel consumed depends on the moisture content of the fuel.[8-9] For most fuel types, consumption during the smoldering phase is greatest when the fuel is driest. When lower layers of the fuel are moist, the fire usually is extinguished rapidly.[10]

The major pollutants from wildland fires are particulate matter (PM), carbon monoxide (CO), and volatile organic compounds (VOCs). Oxides of nitrogen (NO_x) are emitted at rates of from 1 to 4 grams per kilogram burned, depending on combustion temperatures. Emissions of sulfur oxides are negligible.[11-12]

Particulate matter emissions depend on the mix of combustion phase, the rate of energy release, and the type of fuel consumed. All of these elements must be considered in selecting the appropriate emission factor for a given fire and fuel situation. In some cases, models developed by the U.S. Forest Service have been used to predict particulate matter emission factors and source strength.[13] These models address fire behavior, fuel chemistry, and ignition technique, and they predict the mix of combustion products. There is insufficient knowledge at this time to describe the effect of fuel chemistry on emissions.

Table 3.1.2-1 presents emission factors from various pollutants, by fire and fuel configuration. Evaluators should use the "flaming" and "smoldering" emission factors when fuel consumption is known by combustion phase. Otherwise, they should use the "fire-average" emission factors.

Table 3.1.2-2 gives emission factors for prescribed burning by geographical area within the United States. Estimates of the percent of total fuel consumed by region were compliled by polling fire and fuels specialists from the Forest Service. The emission factors are fire-averages and can vary by as much as 50 percent with different fuel and fire conditions.

The regional emission factors in Table 3.1.2-2 should be used only for general planning purposes. Regional averages are based on estimates of the acreage and vegetation type burned and may not reflect prescribed burning activities in a given state. Also, the regions identified are broadly defined, and the mix of vegetation and acres burned within a given state may vary considerably from the regional averages provided.

Fuel Loading Data. Local forestry officials often compile information on fuel consumption for prescribed fires and have techniques for estimating fuel consumption under local conditions. The *Southern Forestry Smoke Management Guidebook*[5] and the *Prescribed Fire Smoke Management Guide*[15] may be consulted to assist in estimating fuel consumption in different regions.

Fuel type	Combustion phase	TSP	PM10	PM2.5[1]	CO[2]
		---------pounds per ton--------			
Douglas-fir/ hemlock	Flaming	24.7	16.6	14.9	143
	Smoldering	35.0	27.6	26.1	463
	Fire-average	29.6	23.1	21.8	312
Hardwoods	Flaming	23.0	14.0	12.2	92
	Smoldering	38.0	25.9	23.4	366
	Fire average	37.4	25.0	22.4	256
Ponderosa/ lodgepole pine	Flaming	18.8	11.5	10.0	89
	Smoldering	48.6	36.7	34.2	285
	Fire-average	39.6	25.0	22.0	178
Mixed conifer	Flaming	22.0	11.7	9.6	53
	Smoldering	33.6	25.3	23.6	273
	Fire-average	29.0	20.5	18.8	201
Piled fuels	Fire-average	28.4	19.0	17.1	169
Juniper	Flaming	21.9	15.3	13.9	82
	Smoldering	35.1	25.8	23.8	250
	Fire-average	28.3	20.4	18.7	163
Sagebrush	Flaming	45.0	31.8	29.1	155
	Smoldering	45.3	29.6	26.4	212
	Fire-average	45.3	29.9	26.7	206
Chaparral	Flaming	30.9	16.5	13.6	103
	Smoldering	39.2	24.4	21.4	198
	Fire-average	35.7	21.2	18.2	159
Wildfire[3]			31.9		

[1] PM2.5 is included because it may be regulated in the future; visibility models may also require PM2.5.
[2] CO is included because it may be important to fireline workers but it dilutes rapidly and should not be a concern downwind.
[3] Wildfire emission factor included for planning associated with prescribed natural fire.

TABLE 3.1.2-1
Prescribed Fire Emission Factors for Common Western Fuel Types

Regional configuration and fuel type[a]	Percent of fuel[b]	Pollutant[c]			
		Particulate (g/kg)			CO
		$PM_{2.5}$	PM_{10}	PM	
Pacific Northwest					
Logging slash					
Piled slash	42	4	5	6	37
Douglas fir/ Western hemlock	24	12	13	17	175
Mixed conifer	19	12	13	17	175
Ponderosa pine	6	13	13	20	126
Hardwood	4	11	12	18	112
Underburning pine	5	30	30	35	163
Average for region	100	9.4	10.3	13.3	111.1
Pacific Southwest					
Sagebrush	35		9	15	62
Chaparral	20	8	9	15	62
Pinyon/Juniper	20		13	17	175
Underburing pine	15		30	35	163
Grassland	10		10	10	75
Average for region	100		13.0	17.8	101.0
Southeast					
Palmetto/gallberry	35		15	16	125
Underburning pine	30		30	35	163
Logging slash	20		13	20	126
Grassland	10		10	10	75
Other	5		17	17	175
Average for region	100		18.8	21.9	134
Rocky Mountain					
Logging slash	50		4	6	37
Underburning pine	20		30	35	163
Grassland	20		10	10	75
Other	10		17	17	175
Average for region	100		11.9	13.7	83.4
North Central and Eastern					
Logging slash	50		13	17	175
Grassland	30		10	10	75
Underburning pine	10		30	35	163
Other	10		17	17	175
Average for region	100		14	16.5	143.8

[a]Regional areas are generalized, e. g., the Pacific Northwest includes Oregon, Washington and parts of Idaho and California. Fuel types generally reflect the ecosystems of a region, but users should seek advice on fuel type mix for a given season of the year. An average factor for Northern California could be more accurately described as chaparral, 25%; underburning pine, 15%; sagebrush, 15%; grassland, 5%; mixed conifer, 25%; and Douglas fir/Western hemlock, 15%.
Dash = no data.

[b]Based on the judgment of forestry experts.

[c]Adapted from Table 11.1-3 for the dominant fuel types burned.

TABLE 3.1.2-2

Emission Factors for Prescribed Burning by U.S. Region

Emission Calculations. The total emissions of pollutants from prescribed fire may be calculated using the following equation:

$$E = EF \cdot L \cdot A$$

where	E	=	Total emissions of pollutant (mass pollutant; tons)
	EF	=	Emission factor for pollutant (mass of pollutant/mass of forest fuel consumed; lbs/ton)
	L	=	Fuel consumed (mass of fuel consumed per unit area of land burned; tons/acre)[5,15]
	A	=	Land area burned (acres)

Example

PM_{10} emissions from a prescribed fire in a hardwoods forest in the Pacific Northwest can be estimated using the following assumptions:

EF	=	12 grams PM_{10} per kilogram of fuel consumed
	=	24 lbs PM_{10}/ton of fuel consumed (note: 1 g/kg = 2 lbs/ton)
L	=	30 tons fuel/acre[5,15]
A	=	40 acres burned

$$E = \left(24 \frac{lbs\ PM_{10}}{tons\ fuel}\right) \cdot \left(30 \frac{tons\ fuel}{acre}\right) \cdot (40\ acres) \cdot \left(\frac{1\ ton}{2{,}000\ lbs}\right)$$

$$= 14.4\ tons\ PM_{10}$$

Hazardous Air Pollutants, Trace Elements, and Ozone.

Hazardous Air Pollutant and Trace Elements. The most important potential for health effects from fires is from exposure to organic hydrocarbons. Several hundred compounds are emitted in smoke from wildland fires[19]. Two of the most important classes of compounds are polynuclear aromatic hydrocarbons (PAHs), and aldehydes.

PAHs are a well-known component of smoke, with some potential for causing cancer in exposured individuals. Examples of PAH compounds include benzo-c-phenanthrene, benzo-a-pyrene, and 3-methylcholanthrene. PAHs do not exist as free gases or vapor in the environment, but are adsorbed onto fine particles that are respirable. For wildland fires, the risk of cancer from PAH emissions is negligible[19].

Of the aldehydes produced in combustion, formaldehyde is the most extensively studied because of its wide use as a process chemical and as as component of adhesive resins. It is an irritant and is allergenic at low concentations. It is known to cause cancer in laboratory animals. Measurements of formaldehyde emissions from fire are not considered reliable, although order-of-magnitude estimates have been constructed from the scant data that exist. Between 1 and 7 grams of formaldehyde per kilogram of fuel consumed is reasonable, with accompanying estimates of 0.5-1 grams per kilogram of acetaldehyde, and 0.05-0.1 grams per kilogram of acrolein[3]. For conservatism, the upper end of each range should be used in any modeling analysis or risk assessment.

Ozone. Wildfires emit large amounts of volatile organic compounds (VOCs) and nitrogen oxides, both precursors of the photochemical oxidant ozone. In remote parts of the United States, the formation of ozone is limited primarily by the availability of NO_x; vegetation is a significant source of naturally occurring VOCs. In these "NO_x-limited environments," the addition of relatively small amounts of NO_x could (under the right weather conditions) lead to the formation of large amounts of ozone.

Ozone is usually not found in the vicinity of fires, but it has been shown to form by photochemical reaction in the tops of plumes[19]. Formation of ozone appears to be limited by penetration of light into the plume; as the plume becomes less dense, ozone concentrations become greater relative to smoke density. Consequently, a fire may contribute a significant fraction to the total ozone load at downwind locations. If the plume comes to ground, it may carry photochemically formed ozone with it. Because ozone is a significant pulmonary and vegetation oxidant, the likelihood that this event would result in high concentrations of ground-level ozone should be considered in the NEPA air quality analysis. Such an analysis would require detailed information on the ozone concentrations at the tops of plumes, the plume dimensions and height, and the meteorological conditions in the vicinity of the fire (e.g., wind speed, atmospheric stability, mixing heights). This information could then be used in a simple Gaussian dispersion modeling analysis to show the ground-level concentrations downwind of the fire. A more refined modeling analysis would include the use of a regional photochemical model.

For more complete information on combustion products and emission estimates from wild and prescribed fire, the reader is encouraged to review Chapter 16 in *Natural and Prescribed Fire in the Pacific Northwest*[19].

Mitigation Techniques[17]

General. Specific mitigation techniques to reduce fire emissions include fuel loading reduction techniques, fuel consumption reduction techniques, techniques for optimizing flaming combustion, and avoidance techniques. One program that effectively combines many of these mitigation measures is seasonal burning. Spring burning, for example, results in reduced fuel consumption and emissions due to high fuel moistures. Spring also may have unstable atmospheric conditions that can lead to better smoke dispersion. Winter burning (usually only applicable to piled fuels) can result in less visibility impairment if burning takes place under conditions of natural impairment such as clouds and fog. However, inversions, which can trap smoke at ground level, tend to be more frequent in the winter.

Fuel loading reduction techniques include: improved utilization (e.g., whole tree yarding, YUM yarding), burning of unit after harvest but before new live fuels appear (applicable to broadcast burns only), and burning in the springtime prior to "green up" (again, applicable to broadcast burns only).

Fuel consumption reduction techniques include: burning concentrations of fuel rather than the entire area, burning when the 1,000-hour fuel moistures are high, burning within 4 drying months of harvest when live fuel moisture is present in large fuels, burning when the duff is wet (during winter or spring or within 5 days of significant rain), using rapid ignition techniques to achieve a high intensity fire, and further utilization of piled material prior burning (firewood, for example).

Techniques to optimize flaming combustion include: burning of piled fuels rather than broadcast burning, careful piling to reduce the amount of dirt in piles, rapid ignition to create a high intensity fire, use of "backing" fires (effective only in light fuels, such as grass, litter, and small woody ground fuels), and prompt "mopping up" of fires after the flames have diminished.

Avoidance techniques include: burning on cloudy days when the plume and residual smoke cannot be seen, during periods of atmospheric instability for better smoke dispersal, and during periods of low visitor use. In addition, real-time monitoring can be performed such that ignition can be halted if smoke impacts become greater than acceptable.

For a more detailed discussion of prescribed fire mitigation techniques, the reader is encouraged to review the U.S. EPA's *Prescribed Burning Background Document and Technical Information Document for Best Available Control Measures*[18].

Firewood Sales. If firewood sales are part of the project, and the firewood will be used in or near a PM_{10} nonattainment area, then additional mitigation measures should be considered. These measures include:

- Increase in permit fees to decrease use

- Decrease in the number of cords allowed by permit holder, or restrict the number of permits issued
- Shorten the gathering season or close the season earlier so that stored wood has more time to dry
- Provide educational materials with the cordwood permit that discusses the use of woodstoves, how to store cordwood to enhance drying, and the adverse health effects of high particulate matter concentrations
- Require that cordwood be split to less than some prescribed dimension (e.g., 6-8 inches in length) prior to removing from the forest
- Require that only dead-and-down wood be removed (i.e., no green wood)
- Permit gathering only on south-facing slopes or from aged piles

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1. *Development of Emission Factors for Estimating Atmospheric Emissions from Forest Fires*, EPA-450/3-73-009, U.S. Environmental Protection Agency, Research Triangle Park, NC, October 1973.

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14. D.E. Ward, et al., "Particulate Source Strength Determination for Low-intensity Prescribed Fires," Presented at the Agricultural Air Pollutants Specialty Conference, Air Pollution Control Association, Memphis, TN, March 18-19, 1974.

15. *Prescribed Fire Smoke Management Guide*, 420-1, BIFC-BLM Warehouse, Boise, ID, February 1985.

16. Colin C. Hardy, *Emission Factors for Air Pollutants from Range Improvement Prescribed Burning of Western Juniper and Basin Big Sagebrush*, PNW 88-575, Office of Air Quality Planning and Standards, U.S. Environmental Protection Agency, Research Triangle Park, NC, March 1990.

17. Peterson, Janice, *Guidelines for Preparing a NEPA Air Quality Analysis*, Mt. Baker-Snoqualmie National Forest (undated manuscript).

18. U.S. Environmental Protection Agency, *Prescribed Burning Background Document and Technical Information Document for Best Available Control Measures*, EPA-450/2-92-003, U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, NC. (September 1992).

19. Sandberg, D.V. and F.N. Dost. 1993. Effects of prescribed fire on air quality and human health. *In:* Natural and Prescribed Fire in Pacific Northwest Forests, J.D. Walstad, S.R. Radosevich, and D.V. Sandberg, editors. Oregon State University Press, Corvallis. pp. 191-218.

B

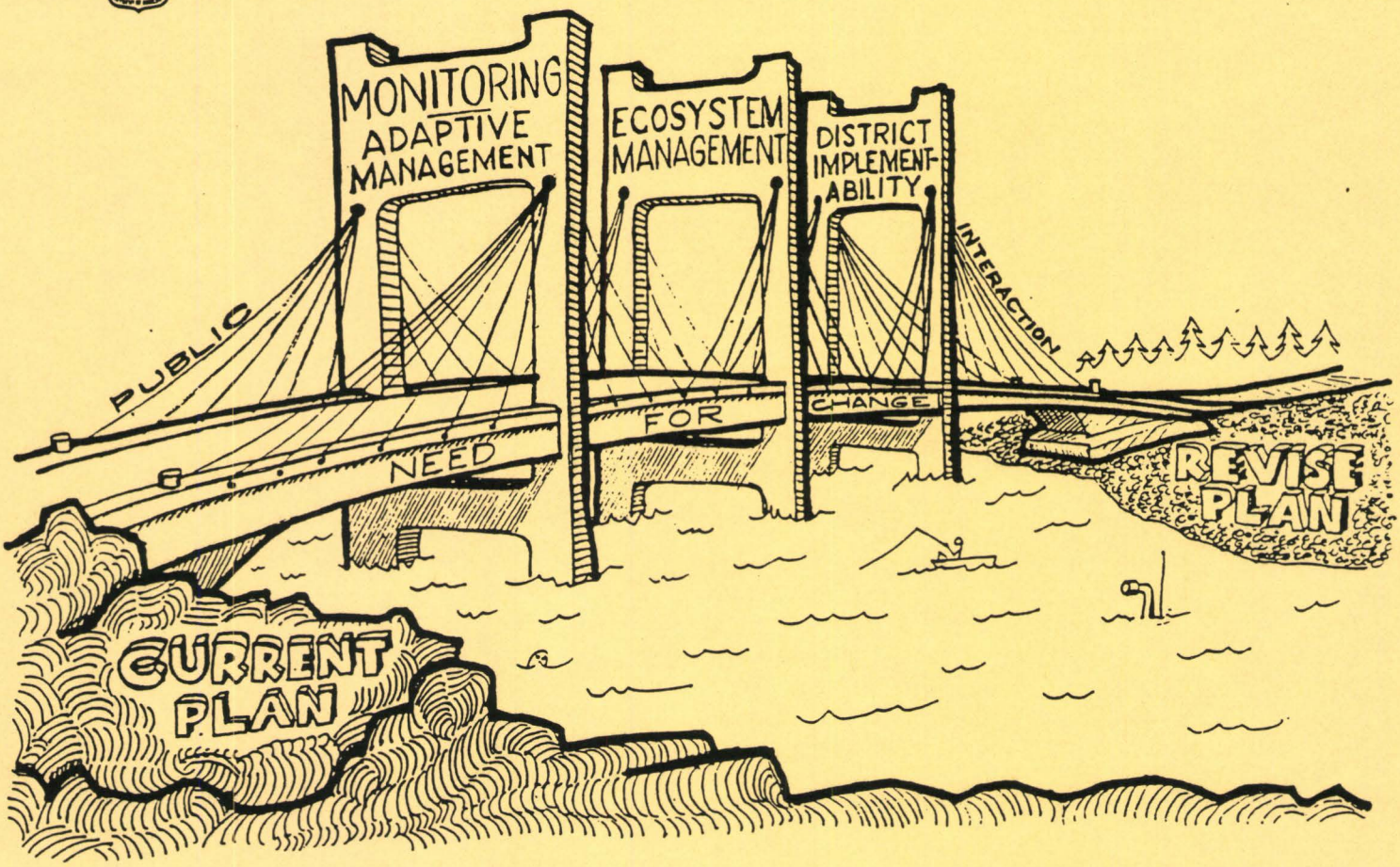
United States
Department of
Agriculture

Forest Service

**Intermountain
Region**

Ogden, Utah

DeskGuide



Bridge To Revision

October 1993

OPERATIONAL!

APPENDIX B - PLANNING ADVICE

The following planning advice has been developed to guide revision of Forest Plans for specific issues. As more information is gathered through implementing the DeskGuide and through changing national direction this appendix will be updated.

The information is organized by the three integrated integrated goals described in Appendix E. Additional standards and guidelines related to management of these resources are also shown in Appendix E.

I. PROTECT AND MANAGE ECOSYSTEMS

Physical and Abiotic Resources

Groundwater Aquifer Management: Effective management of geologic resources such as groundwater are necessary and important part of National Forest management. National Forest System lands include major groundwater recharge areas, which furnish a continuous supply of fresh clean water to dominant groundwater aquifers. Forest Planning should include the location and an assessment of these groundwater recharge areas. Forests should work with the U.S. Geological Survey, and various state and local agencies to identify these areas and groundwater quality standards.

Smoke Management: Smoke management plans and activities for prescribed fire (Rx) will be consistent Forest-wide: To include determination of, and response to, Smoke Sensitive areas, health, safety, and compliance with the Interagency Prescribed Fire Smoke Guide NFES No. 1279, February 1985.

NEPA documents will address prescribed fire smoke through an air quality analysis which will include: Existing air quality, visibility, public/worker health and safety mitigation, Smoke Sensitive Areas, meteorologic conditions, purpose, size, and type of burn, pre-burn fuel conditions, duration of burn, location, dispersion model used and input/output data. It must determine that the proposed prescribed fire smoke will not cause or contribute to: any violations of the State and local Air Quality Regulations, National Ambient Air Quality Standards, pm<10 and visibility standards, Class I and II Airshed CAA increments, significant impairment of Class I visibility, and provides for health and safety.

Rationale: When we use prescribed fire as a management tool, we have choices. One of the choices is to manage the smoke along with the fire consistent with the health and safety requirements of air quality standards and existing laws, rules, regulations, and agreements. Smoke management is practiced on some units - albeit inconsistently. References: Include: the 1977 and 1990 Federal Clean Air Act Amendments, State Air Quality Regulations, USDA Forest Service/State Air Quality MOU's, FSM 2580, NEPA, MUSY and Wilderness Act, US EPA Technical Guidance Document for State Air Quality Bureaus titled: Prescribed Burning Background Document and Technical Information Document for Best Available Control Measures July 1992. The Manti-LaSal NF Smoke Management Guidelines for Prescribed Fires March 1992.

Plant and Animal Communities

Diversity of Plant and Animal Communities: Forests will manage ecosystems in a manner that ensures the diversity and representativeness of plant and animal species and communities. Diversity, rarity and representativeness will be considered within the context of the range of natural variability over space (regional to local) and time.

Conservation requirements for biodiversity are determined through assessment of factors that have contributed to its loss, including: habitat destruction, fragmentation, and simplification; pollution; over harvesting; introduction of exotics; and disruption of natural processes. Biological resources are protected, managed, and restored at geographic scales commensurate with the scale of the systems that sustain them.

Forests should consider the following when assessing biodiversity:

- Promoting natural patterns of ecosystems across the landscape.
- Maintaining or emulating natural ecosystem processes.
- Maintaining or emulating naturally occurring structural diversity.
- Promoting native species; avoid introducing non-native species.
- Protecting unique or sensitive environments, such as wetlands, snags, riparian communities, bogs, seeps, talus slopes and vegetation stands that meet the definitions of old growth.
- Protecting rare and ecologically important species, including those with naturally limited ranges, those facing extinction, and keystone species.
- Protecting genetic diversity of plant and animal species.
- Restoring degraded ecosystems and under represented plant and animal communities and species, to the extent possible.

Required Reference: Council on Environmental Quality. 1993. Incorporating biodiversity considerations into environmental impact analysis under the National Environmental Policy Act. CEQ Rept., Wash., D.C. 29pp.

Old-Growth Management: The final report "Characteristics of Old-Growth Forests in the Intermountain Region" was issued May 19, 1993. Forests should use this information in preparation of Forest Plans.

APPENDIX E - REGIONALLY CONSISTENT FOREST-WIDE STANDARDS AND GUIDELINES

INTRODUCTION

Following are the areas for which each Forest Plan must include standards and guidelines. Forests must use these standards or recommend new standards for approval. At the end of the standards and guidelines section is an approach for grouping standards and guidelines to achieve more integration.

PHYSICAL STANDARDS AND GUIDELINES

CLASS I AIRSHED AIR QUALITY RELATED VALUES

Forest plans will establish the Air Quality Related Values (AQRV'S) for Class I and II Wilderness Airsheds. The Sensitive Receptors (SR) for each AQRV (i.e., water chemistry = AQRV and alkalinity = SR) will be established, and the Limits of Acceptable Change (LAC) level established.

Alpine ecosystem Class I Airsheds require the following AQRV, SR, and LAC levels which have been established with scientific and public input.

AQRV = Water
SR = Alkalinity
LAC=Standard: Alkalinity will not be reduced more than 10 percent of baseline in all surface waters.

AQRV = Terrestrial
SR = Sulphate deposition
LAC=Standard: Sulphate deposition will not exceed 5 kg/ hectare.

AQRV = Visibility
SR = Visual Range
LAC=Standard: Visual range will not be reduced more than 5 percent of baseline 90th percentile (clean days).

Rationale: The alpine ecosystems are most sensitive to air pollution and contain Class I and most Class II Wilderness Airsheds. State of the science, public AQRV workshops and State air quality hearings support these AQRV's, SR's, and LAC standards established for alpine ecosystems. These issues are addressed in the R4; albeit inconsistent way.

References: The 1977 and 1990 Clean Air Act Amendments, State Air Quality Implementation plan's, laws, regulations, FSM 2580, USFS Research Technical Report No. RM 146 and RM 168, and the Bridger-Teton NF public workshop proceedings titled: Air Quality and Acid Deposition Potential in the Bridger and Fitzpatrick Wildernesses, March 1984.

VISIBILITY PROTECTION

Long-term visibility impairment from (inservice or outservice) human activities will not impair long term baseline visual range more than 5 percent of the 90th percentile (clean days) in Class I Airsheds, nor more than 10 percent in Class II wilderness airsheds.

Short-term (14 day) visual range impairment from human activities outside the wilderness (inservice or outservice) such as Rx fire smoke will not reduce pre-activity visual range more than 10 percent of the 90th percentile in Class I Airsheds or 20 percent in Class II Wilderness Airsheds. This standard allows for the natural role of fire and smoke from Rx natural wilderness ignitions to maintain the ecosystem.

Rationale: The Congress in the CAA established visibility as an AQRV and set policy. USFS, NPS, and EPA surveys indicate that visibility (clean air-distant views) is a national treasure on the public lands that citizens expect to be protected, maintained, or improved. The CAA and Wilderness Act hearings further demonstrate that visibility is a national concern, goal, and priority.

References: Include: Wilderness Act, 1977 and 1990 Clean Air Acts, public and EPA comments on NEPA documents, State Air Quality hearings, Air permit hearings, and the National Academy of Science Report Visibility in National Parks and Wildernesses, February 1993.

WATER QUALITY

Forests shall meet or exceed State water quality standards. Point source pollutants will be controlled in accordance with appropriate state permit systems. State regulations contain point source numerical standards.

Nonpoint source pollutants will be controlled by selecting appropriate Forest Service soil and water conservation practices (see FSH 2509.22) or State certified best management practices (BMP's) based upon site conditions and in stream beneficial uses. Onsite and instream monitoring is conducted to assure that practices are implemented as planned and are effective in meeting onsite and instream management objectives.

STREAM ZONE BUFFER STRIPS

Forests will establish criteria for management of buffer zones along all streams supporting beneficial uses or their tributaries. Until such time that the Forests do establish buffer strip width criteria the following minimum standard will be used Region wide. Minimum buffer strip widths will be 25 feet plus 2 feet for every percent side slope adjacent to the stream (1). Buffer strips need not be unmanaged corridors, but carefully designed units where riparian and aquatic values are given highest priority for the protection of instream beneficial uses.

MESSAGE DISPLAY FOR CLIF BENOIT

To JAMES GERBER:R04F15A
CC T.PATTEN
CC C.BENOIT

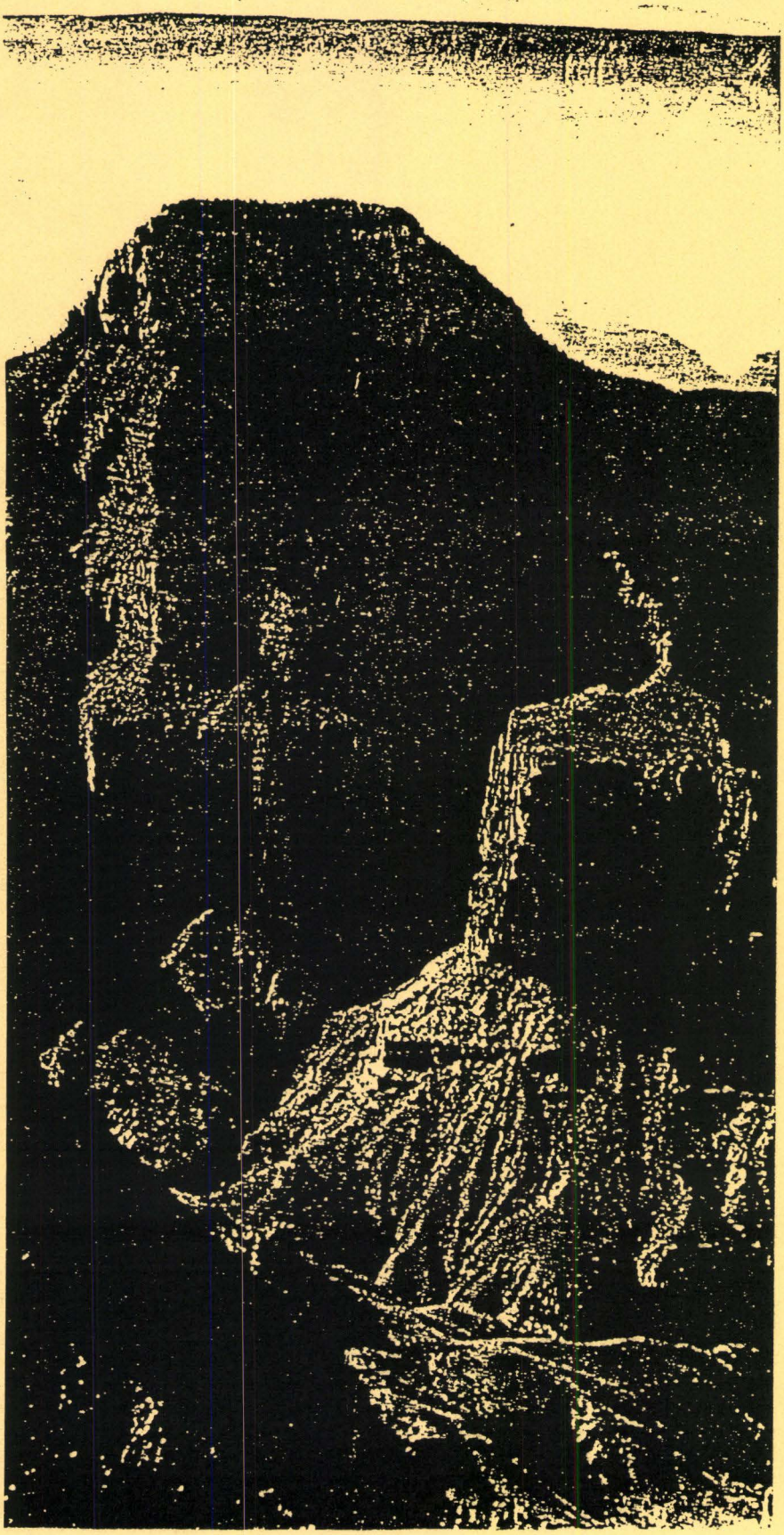
From: Clif Benoit
Postmark: Feb 08,94 3:31 PM Delivered: Feb 08,94 3:31 PM
Status: Previously read
Subject: Reply to: Forest-wide Standards and Guidelines

Reply text:
From: Clif Benoit:R04A
Date: Feb 08,94 3:31 PM
EXAMPLE:LET"CLEAN DAYS"90 PERCENTILE VISIBILITY EQUAL 200 MILES.
LONG TERM IMPACT-MORE THAN 14 DAYS...NOT TO EXCEED-NTE
CLASS 1 - NTE 5%- 10 MILES - COULD REDUCE TO 190 MILES
CLASS 2 - NTE 10%-20 MILES - COULD DIRTY TO 180 MILES
SHORT TERM IMPACT- LESS THAN 14 DAYS
CLASS 1 - NTE 10 % - 20 MILE - DIRTY TO 180 MILE NTE 14 DAYS
CLASS 2 - NTE 20 % - 40 MILE - DIRTY TO 160 MILE NTE 14 DAYS
THE ABOVE ARE FOR CLASS 1 AND 2 CLEAN AIR ACT WILDERNESS AREAS ONLY!
LONG TERM:ARE POWER PLANTS,SKI AREAS,SMELTERS,GRAVEL PITS,BOILERS ETC
SHORT TERM:ARE RX BURNS(NOT PNF),PORTABLE ASPHALT PLANTS,TEMPORARY
ROCK CRUSHERS,FIELD BURNING,FUEL RELOAD POINTS,ROAD SWEEPING ETC.
NOTE: THESE ARE EXTERNAL VISIBILITY IMPAIRMENTS THAT IMPACT THE CLEAN
DAY VISIBILITY INSIDE THE WILDERNESS...OFTEN THE STATE MITIGATES
THE AIR QUALITY PERMIT TO COMPLY WITH THESE STANARDS...CAA MANDATES
WE ESTABLISH THE VISIBILITY AIR QUALITY PROTECTION VALUES.

Preceding message:
From: JAMES GERBER:R04F15A
Date: Feb 08,94 2:35 PM
What does the following mean in plain language, for us mere mortals:
Human activities will not impair the long-term baseline visual range
more than 5 percent of the 90th percentile (clean days) in class I
Airsheds, nor more than 10 percent in Class II wilderness airsheds.
Short-term (14 days) visual range impairment from human activities
outside of wilderness, such as prescribed fire smoke, will not reduce
pre-activity visual range more than 10 percent of the 90th percentile
in Class I Airsheds or 20 percent in Class II Wilderness Airsheds.

-------X-------

The Grand Canyon Visibility Transport Commission



Recommendations for Improving Western Vistas

June 10, 1996

United States Department of Agriculture | Forest Service | Washington Office | 14th & Independence SW
P.O. Box 96090
Washington, DC 20090-6090

File Code: 2580
Route To : 5100

Date: JUL 26 1996

Dick

Subject: Grand Canyon Visibility Transport Commission Recommendations that Affect the Forest Service

To: Regional Foresters, Station Directors, Area Director IITF Director, and WO Staff

On June 10, 1996, the Grand Canyon Visibility Transport Commission, chaired by Governor Symington, submitted its Recommendations for Improving Western Vistas to the U.S. Environmental Protection Agency (EPA). This fulfilled the Commission's congressional mandate as described in the 1990 Clean Air Act Amendment. That mandate was to develop a comprehensive set of air pollution control recommendations to address adverse impacts to visibility on the Colorado Plateau now and into the future. The enclosed report is based on 4 years of assessment of scientific and technical data and reflects a consensus of Federal, State, tribal, and local governmental, environmental, and industrial entities as well as the public-at-large. The Southwestern Regional Forester has represented the Forest Service in these proceedings with direct support from all western regions.

The overall Commission's Recommendations are a balance between the protection of Class I areas (one responsibility of the FS) and the realistic control of sources of air pollution (including Forest Service sources). The Commission's Recommendations address prescribed fire activities (with a very strong statement recognizing the importance of prescribed fire in ecosystem management), emissions within and near our Class I Wilderness Areas, and the future of the Commission, all of which will affect the agency. The Commission's Recommendations also address mobile sources (planes, trains, and automobiles), stationary sources (power plants, smelters, and others), Mexican emissions and pollution prevention. These are the controls that will greatly reduce the transport of pollution that affects the visibility in our Class I areas.

The Commission looked at the Western States and developed recommendations to address the conditions there. It is likely that these recommendations will have much broader, national implications and that is the reason I am sharing these results with all of you.

The Commission's Recommendations will be integrated into EPA's Regional Haze Rule which will be promulgated in mid-1997. This integration process is occurring through the Subcommittee for Ozone, Particulate Matter and Regional Haze Implementation Programs of the Clean Air Act Advisory Committee. As Chief, I am a member of that Subcommittee and have Washington Office staff involved in the work of groups developing implementation alternatives.

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As a result of the Commission's Recommendations, I am initiating a number of internal actions to assess the impact on personnel and budget and to develop a plan of action to be issued in October 1996.

On-going Commission Activities: The Southwestern Regional Forester and the current multi-regional support staff will continue to represent the agency in on-going Commission activities and will lead the current internal communication process.

Coordination with DOI and NRCS: As the Commission's Recommendations will affect other Federal land management agencies in a similar fashion, a group has been established to coordinate with the NRCS and the DOI.

Coordination on Prescribed Fire Issues: The Commission's Recommendations for prescribed fire will be addressed internally and on an inter-agency level via the Federal Fire and Aviation Leadership Council and their Fire Sciences Council.

Integration Into Assessments and Forest Plans: Implementation of the Recommendations by the FS will require their consideration in large scale eco-regional assessments and in the development of standards and guidelines through forest land management planning. As we now begin the revision of forest plans, it is imperative that this process is closely linked to land management planning and analysis at the forest and regional levels. Because agency impacts (fiscal and personnel) cut across all functional resource areas, WO Ecosystem Management (EM) will take the lead in coordinating this process assisted by WO Watershed and Air Management and WO Fire and Aviation Management.

Budget, Staffing, and Tasks: I have asked the Director of WO-EM to also utilize the WO-EM Directors Group to determine the appropriate agency course of action in response to the Commission's Recommendations. Further assessment of future prescribed fire use and other emission producing activities will occur over the next 3 years. Budget priorities could potentially be affected as the implementation is national in scale.

Questions may be directed to the Southwestern Regional Forester or the Director of WO Watershed and Air Management. You may anticipate further communications regarding the plan of action development and the subsequent implementation of the Commission's Recommendations.

/s/ Jack Ward Thomas

JACK WARD THOMAS
Chief

Enclosure

FIRE

Background: Fire Emissions and Visibility

Fire has played a major role in the development and maintenance of most ecosystems in the West. The long-term future of the West is dependent on healthy ecosystems that are capable of sustaining natural processes and human uses.

An increase of accumulated forest fuels in the West has occurred because of past land management practices, including decades of fire suppression. Evident ecosystem changes include increasing tree densities, disrupted nutrient cycling, and altered forest structure. As a result, wildfires are becoming larger in size, unnaturally destructive, and more dangerous and costly to control. In 1994, wildfire burned 3.1 million acres in the West and cost $1 billion dollars in direct suppression costs while causing firefighter deaths and serious human health impacts. Rectifying this problem will take years and is a basic responsibility of wise land stewardship. Fire is an essential component of most natural systems, and perpetuation of fire at a level required to maintain ecosystem processes is necessary. The natural role of fire in the wildland/urban interface must also be addressed to protect life and property. A substitute for fire and its natural role has not been found in many ecosystems. The objective of future prescribed fire programs is to cooperatively meet land management, human health and visibility objectives.

Emissions from fire (wildfire and prescribed fire) are an important episodic contributor to visibility-impairing aerosols, including organic carbon, elemental carbon, and particulate matter ($PM_{2.5}$). Agricultural burning emissions and their effects have been identified as a concern of the GCVTC but have not been quantified due to a lack of data. All types of fire (prescribed fire and agricultural burning) must be addressed equitably as part of a visibility protection strategy. This may require state legislation in some cases.

Discussion of Management Alternatives

Wildfire impacts are increasingly uncontrollable or unmanageable, due to excessive fuel loads, except through the application of prescribed fire and/or mechanical means, such as brush removal and logging. Field experience has shown that prescribed fire can reduce the size, frequency, and intensity of wildfires. Areas that have been treated with prescribed fire demonstrate much less burning in the tops of trees and a slowing of wildfire spread. Prescribed fire therefore promotes better fire control, predictable fire effects and allows for management of emissions as compared to wildfire.

The future use of prescribed fire and the restoration of fire in its natural role with natural fuel loadings will provide sustainable ecosystems where environmental and human health impacts can be managed. This future desired situation contrasts with the current adverse public health impacts and permanent damage to natural resources and property from wildfires. Wildfires are causing exceedances of ambient air quality standards and air quality-triggered community evacuations with greater frequency. Prescribed fire

programs will influence future wildfire in many locations of the West. However, infrequent large-scale forest replacement wildfire will still occur naturally in some vegetation types.

Land managers employ emission reduction and smoke management techniques to reduce air quality impacts of prescribed fire. Current smoke management techniques take into account the timing and location of burns so that impacts on human health are reduced. These techniques can be expanded to reduce current and future impacts on visibility. Emission reduction techniques can also be utilized to reduce the quantity of emissions from a prescribed burn. The appropriateness and effectiveness of emission reduction techniques vary based on vegetation type, burn objectives, location, other environmental constraints such as water quality, and funding. Effective agricultural smoke management programs have been developed in some states using similar measures.

Utilization of mechanical treatments such as logging or firewood sales to remove fuels will be necessary in some areas prior to prescribed burning. The potential use of mechanical treatments is limited, however, since large areas of the West are not physically available due to inaccessibility, slope or soil sensitivity. Significant emission reductions from mechanical treatment would only occur in timber areas. Administrative constraints, such as wilderness or habitat protection, also impose limitations. Approximately 30% of the total timber area has the potential to be treated using mechanical methods. In areas where mechanical treatments are used alone, some level of prescribed fire treatment may still be necessary. Mechanical treatment cannot replace the natural role of fire in ecosystem health and sustainability processes.

In order to address the fuels problem and ensure adequate protection of visibility in the West, funds will need to be greatly increased. With the development of increased prescribed fire programs, it is crucial to fund smoke management programs that protect public health and visibility, while meeting the underlying land management objectives.

RECOMMENDATIONS REGARDING FIRE

1. Plan for the visibility impacts of smoke.

The Commission recommends that the EPA require all federal, state, tribal, and private prescribed fire programs to incorporate smoke effects in planning and application by the year 2000.

2. Implement an emissions tracking system for all fire activities.

A consistent emissions tracking system for prescribed fire, wildfire, and agricultural burning should be implemented region-wide.

3. Improve integrated assessment of emissions.

Federal, state, tribal and private land managers, in conjunction with relevant regulatory agencies and interested parties, should improve the current integrated assessment of emissions from prescribed fire, wildfire and agricultural burning by 1999. The assessment should:

a) identify specific areas where fire activities have or could have an adverse impact on health and visibility;

b) identify areas where mechanical treatments could substantially reduce emissions and subsequent impacts on health and welfare;

c) in the areas identified, assess the feasibility of biomass utilization (woody material use), market development, and non-statutory administrative barriers[11]; and

d) assess meteorological information needs, air quality monitoring needs, smoke dispersion model needs, interstate planning needs, wildfire/prescribed fire trade-offs (economics, air quality and other resource effects), and emission factor research (vegetation/fuels and effects of emission reduction techniques).

4. Enhance smoke management programs.

The Commission recommends the development and implementation of criteria and requirements for the use of enhanced smoke management programs (including alternative management practices) and emission reduction strategies in the identified areas. Such programs should consider factors of efficiency, economics, law, land management objectives, and reduction of visibility impacts. States, tribes, state and federal land management agencies and private parties should create and implement smoke management programs that address public health, visibility and land management objectives by the year 2000, using the results of the assessment listed in Recommendation #3.

5. Develop cooperative funding mechanisms.

The Commission promotes the development of cooperative funding mechanisms between burners and regulatory agencies to implement increased smoke management programs and integrated assessment costs.

6. Promote public education programs.

[11] In identifying areas where alternatives to burning are appropriate, it is not the intent of the Commission to require actions that are inconsistent with applicable laws or regulations.

The Commission supports the creation of a public education program regarding the role of fire in air quality, to be undertaken by land managers and other interested governmental and private groups.

7. Establish annual emission goals for fire programs.

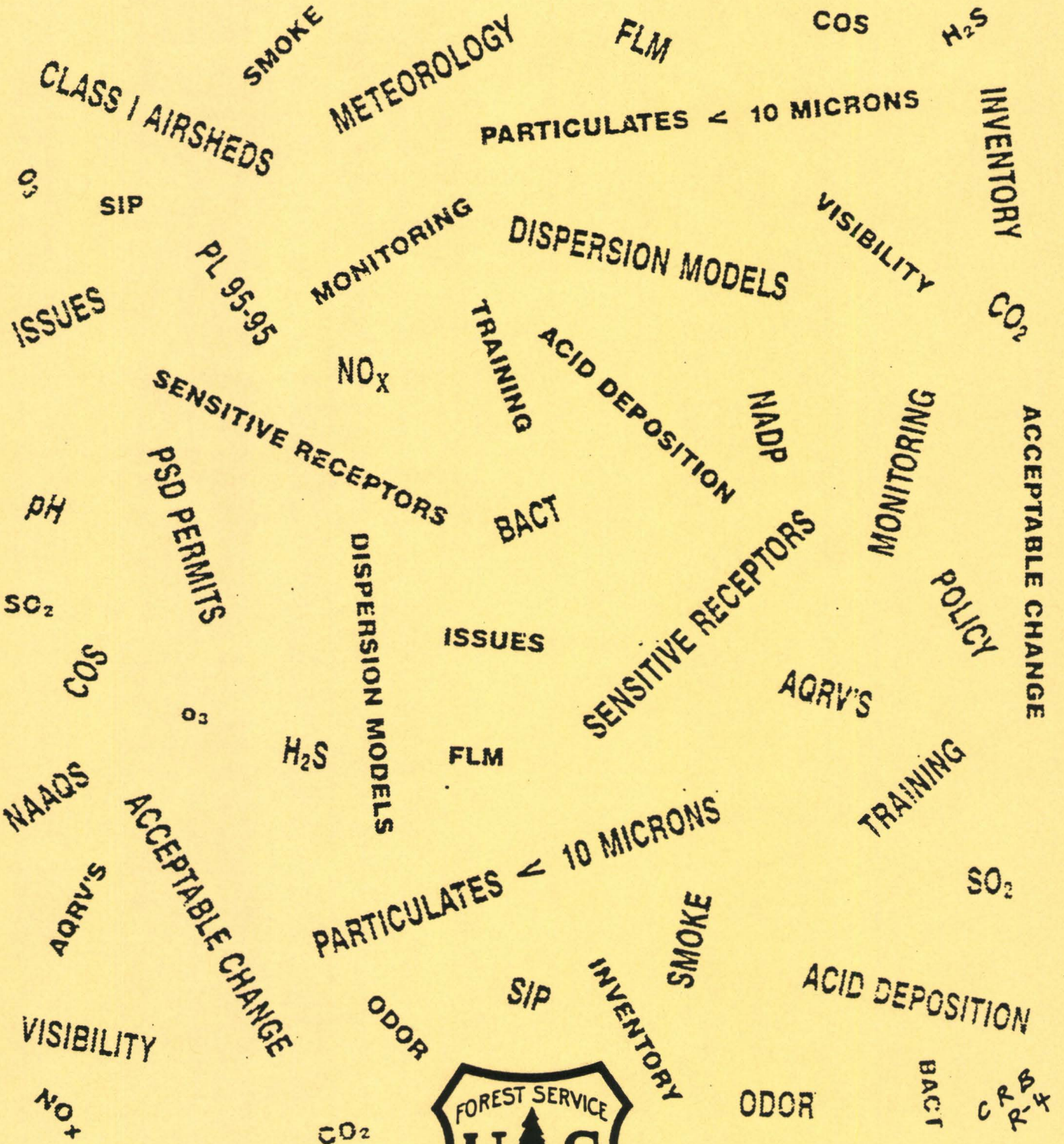
The Commission recommends that annual emission goals for all fire programs, where appropriate, be established by the year 2000. These goals will be set to minimize emission increases from such programs to the maximum extent feasible. The goals will be established cooperatively by states, tribes, state and federal land management agencies and their private sector counterparts.

8. Remove administrative barriers to the use of alternatives to burning.

The Commission recommends that the federal land management agencies and their state, tribal, local and private counterparts identify and remove non-statutory administrative barriers to emission reduction strategies by the year 2000, to the maximum extent feasible. In removing such barriers, the Commission intends that subsequent actions will be undertaken consistent with applicable laws and regulations.

AIR RESOURCE MANAGEMENT

LMP Revision PROGRAM



U.S. Forest Service
Intermountain Region

AIR RESOURCE MANAGEMENT

June 26, 1992

The following plan revision guidance is suggested as a way to integrate air resource management into the ecosystem specific Forest planning level. If you have questions, contact Clif Benoit, Air Resource Officer, R04A. His telephone number is (801) 625-5594. The new Clean Air Act (1990) mandates air resource as a Forest plan revision issue for Federal land managers.

ANALYSIS OF THE MANAGEMENT SITUATION

These are some of the key issues that have recently changed your Air Resource Management Situation.

1. Amended Federal Clean Air Act (850 pages) November 15, 1990.
2. EPA direction to use smoke dispersion models for Rx fires (EPA R-10 8/14/91).
3. States of Utah, Idaho, Nevada, California, Wyoming, and Colorado EPA approved Air Quality State Implementation Plans (SIP).
4. EPA direction to quantify Rx fire smoke emissions (EPA R-10 8/14/91).
5. EPA policy, "Do not contribute to visibility impairment."
6. EPA particulate matter less than 10 micron (PM<10) standards and compliance. Rx smoke and fugitive dust are now public health issues.
7. Class I and II Wilderness/visibility protection policy formulated at the Interagency Denver Workshop, 02/90 (Dave Unger, Chairman).
8. Congressionally Mandated air quality protection of downwind Class I and II areas, such as Wildernesses, National Parks, and new wilderness additions.
9. Toxic air pollutants in wood smoke, (EPA/CAA).
10. State Air Quality Revised Regulations.
11. USDA Forest Service Regions 1, 4, and 6, and State of Idaho Cooperative Air Quality Memorandum of Understanding, February 5, 1988.
12. States ability to charge Federal land managers per-ton of pollution emitted.
13. Air pollution emissions inventory requirements.
14. USDA Forest Service R-4, Utah BLM, and Utah Air Quality Bureau MOU.
15. USDA Forest Service Cooperative MOU with Nevada Air Quality Bureau.

16. New Wilderness designations and additions to Class I Airsheds.

17. Forest Service policy that visibility is a National Resource to be protected (See Item 7).

18. Air Quality Related Values established for Class I Wilderness Airsheds.

19. Western Governors Association (WGA) Visibility Transport (protection and improvement) Congressional Commission.

PUBLIC ISSUES AND CONCERNS

The public at the national, regional, and local level has consistently told us and other Federal land managers of their concerns for:

1. Clean air.

2. Toxic air pollution.

3. Visibility impairment --particularly in Wilderness and National Parks.

4. Residual Rx fire smoke.

5. Unnecessary burning of forest fuels.

6. Protection of Wilderness/roadless Air Quality related issues.

7. Acid rain effects on surface waters.

8. Road dust health and safety.

9. Ozone damage and forest health.

10. Air pollution impacts from permittee activities.

PLANNING CRITERIA

The following criteria need to be included in your revision planning process.

1. The April 28, 1990, R-4 FSM Supplement (No. 75) 2580.1, sets Regional air resource direction.

2. The February, 1990, R-4 FSM supplement (No. 56) 1561.8, 1 to 22 contains the Memorandum of Understanding between Idaho, Nevada, and Utah State Air Quality and the USDA Forest Service, Regions 4, 1, and 6. It establishes working criteria and cooperation between the two agencies in air quality matters.

3. The Interagency Prescribed Fire Smoke Management Guide, 420-1, produced by the National Wildfire Coordinating Group and the Prescribed Fire Effects Work Group, revised February, 1985.

4. The R-4 Regional Guide for Planning, Air Quality section pages 2-30 to 2-32, dated January, 1984.

5. The State of Idaho, Nevada, Utah, Wyoming, and California Air Quality Code of Regulations and the EPA approved State Clean Air Act Implementation Plan.

6. Air Resource Management Handbook-FSH 2509.19.

7. WO Air Resource Management Manual, FSM 2520.

8. WO Wilderness Manual, FSM 2320.

9. FSM Rx Fire Manual/Handbook (5100).

10. Screening procedure to Evaluate Air Pollution Effects, published by the USFS Rocky Mountain Forest and Range Experiment Station, Report RM-168, January, 1987.

11. Guidelines for Measuring Physical, Chemical, and Biological Conditions of Wilderness Ecosystems, published by the USFS Rocky Mountain Forest and Range Experiment Station, Report RM-146 November, 1987.

12. Prescribed fire smoke dispersion models such as SASEM and PNW Research models for Rx smoke.

13. EPA air pollution guidance document AP-42, concerning emission factors and efficiency of control treatment measures.

14. Baseline air quality data requirement for R-4 Class I and II Wilderness Airsheds.

15. Forest Smoke Management Plan. Example for Manti-Lasal NF, 07/92, contact John Patten, Manti-LaSal Forest or Clif Benoit, RO.

16. A speech entitled, "Federal Land Managers in Air Resource Management", by USFS Chief, Dale Robertson, is enclosed.

17. Smoke management speech by Max Peterson, retired, USFS Chief, is enclosed.

COLLECTION OF DATA

The data required for Smoke Management is outlined in the State/USFS Air Quality Memorandum of Understandings, and in the Interagency Prescribed Fire Smoke Management Guide 420-1. Onsite meteorologic data from remote automated weather stations and the National Fire Weather Forecast System is required. The USFS and BLM smoke dispersion model SASEM is accepted by the States and EPA. The model data needs are outlined in the user guide.

Visibility data is collected by the National Park Service at all parks. The USDA Forest Service collects and monitors visibility data at the Sawtooth, FCRNR, Teton-Bridger Wildernesses, Jarbidge, High Uinta, Hells Canyon, and Hoover Wildernesses. Other air quality related value data has been collected, such as water chemistry, PM<10, lichen biomonitors, glacial and sediment cores, and atmospheric chemistry.

Other data sources and protocol methods are outlined in the USDA Forest Service RMFRES technical reports RM-168 January, 1989 and RM-146 November, 1987.

It is the land managers responsibility under the Clean Air Act to establish the baseline Air Quality Related Values; such as visibility, odor, atmospheric chemistry, acid deposition, ozone, and global warming Co2 on Federal forest and range lands.

FORMING ALTERNATIVES

It is unlikely that air will be a basis for formulating a single alternative. Since the air resource is a most basic resource, it should be described from a quantifiable effects standpoint under all alternatives. Air Resource Management is a planning issue during the revision process. Even if the public does not raise it---the law does. It is important to realize that States have regulatory power over air resource on National Forest lands through the 1990 Clean Air Act with EPA oversight. The Federal land manager has the responsibility to protect or improve the Air Quality Related Values in Wilderness Airsheds, and manage our air related activities and those of our permittees within State air quality regulations.

ESTIMATING THE EFFECTS

The effects description should include: The frequency, duration, time of year, health effects, toxic effects, visibility impairment (reduction), quantity of particulate emissions, and acid deposition effects on the aquatic resources. The above should be quantified since qualitative judgements are no longer defensible to EPA and the public.

EVALUATING ALTERNATIVES

The alternatives can be quantifiably compared and evaluated using some of the following:

1. Seasonal tons of particulate created.
2. Tons of acid deposition precursors created.
3. Percent of baseline visual range reduced by
    a. frequency
    b. duration
    c. season
    d. location
    e. class I Airsheds
    f. class II Wilderness Areas
4. Global climate change impact as expressed in tons of CO^2

Monitor and Evaluation

This is discussed in detail in a USDA Forest Service paper enclosed and titled: Air Resource Monitoring Requirements by McLaughlin, Byrne, and Benoit.

Role of Federal Land Managers in Air Resource Management

Speech given by F. Dale Robertson, Associate Chief, USDA Forest Service, at the National Advanced Resource Technology Center, Marana, Arizona, for the National Air Quality for Federal Land Managers Course, given December 5, 1982.

I would like to discuss with you for a few minutes the importance of the air resource management job to be done by the Federal land management agencies.

In many respects our responsibility to protect air quality is complex with the many requirements of the Clean Air Act and associated regulations. Yet, it is also a relatively simple job to understand in concept.

So, let's start with the simple. The Federal land management agencies who are responsible for managing about one-third of the United States can have a significant effect upon the quality of the air that we breathe. We have a basic responsibility to be good stewards of the land, water, and air. We've always been very sensitive to protecting the soil and water resources, but I'm not so sure we've been as equally concerned about air quality. So, the first thing we need to do is to make sure our set of basic stewardship principles are broadened to incorporate air quality as a basic consideration in all of our land management decisions. If we do this with a commitment to protect air quality, many of the details will fall into place. If you ever tried to wade through the one-hundred-eighty-five page Clean Air Act, you will see why this is important.

Let's review some of the requirements of the Clean Air Act as it relates to our role as a Federal land management agency. Clean Air Act follows a pattern of several other laws passed in the last 10 to 15 years. Congress set forth National goals land target dates for accomplishment. In this case, EPA was delegated the authority to set National air quality standards and issue implementing regulations. Implementation Plans to meet the National air quality standards were prepared by States and local governments with technical and financial assistance from the Federal government. The Act also provides enforcement tools to make sure the job gets done. EPA approves the Implementation Plan and if State fails, EPA is to do the Plan for them.

There are a couple of unusual features to the Act. The Clean Air Act is more detailed than most acts. A major point is, the Federal agencies do not have Federal immunity and must comply with both substantive and procedural requirements of State Implementation Plans.

As I see it, the Federal land management agencies have three special roles:

1. —Cooperate with EPA and States and local governments and become an active participant in their process to set standards and develop implementation plans. They are agencies which have a big job to do with limited resources. They need our expertise and help to make sure standards and procedures are realistic. If we lay back and don't participate in a positive and constructive way, then we deserve to live with what we get.

2.—Federal land management agencies are polluters ourselves and, as I said before, the law requires us to meet both the substantive and procedural

requirements of the Clean Air Act and State and local government Implementation Plans.

We must meet the minimum standards. However, in most cases we have considerable discretion to determine how far we go beyond to help meet the more general goal of protecting and enhancing air quality so as to promote public health and welfare.

As you know, a major emphasis of the Reagan Administration is to put government on a more business-like basis by taking a hard look at costs/benefits. It is particularly important to examine marginal cost/benefits to make sure the last increment of benefits is worth the additional cost. But, this means that we need to know what we're doing--we've got to have technical expertise to determine and evaluate the effects of proposals on air quality. But we also need to go further and know how to mitigate unacceptable impacts so that we can get our mission accomplished.

This is not much different from our personal financial situation--where we constantly have to evaluate the relative cost benefits of the various ways we could spend our limited income--we should have the same mind set when we spend the taxpayers' dollars in all of our programs. We just can't afford to lose sight of this fact of life.

3.—Finally, the Federal agencies have an affirmative responsibility to protect or enhance the air quality of Class I Areas including visibility.

This puts Federal land management more in a regulatory role which is new to most of us. If we can demonstrate that a major facility will have an adverse effect on Class I Areas, the project cannot proceed unless the Governor disagrees and refers the decision to the President. That is a rather awesome responsibility that we should take seriously with the exercise of good judgement and probably a lot of negotiations in most specific cases.

So to summarize:

— We must consider air quality as part of our basic stewardship responsibility.

— We must become active participants in the process to help set the rules by which we will live.

— We must meet standards and procedural requirements of State and local governments and finally, affirmatively protect air qulity in Class I Areas.

So what does all of this mean?

We've got a big, important job to do. Management needs to have a good understanding of our responsibility and what we're trying to achieve and put air quality in perspective to the total job. We've made some progress, but more progress is needed in order to get on top of the job. We need a well trained cadre of people who know their business in terms of Air Resource Management.

SMOKE MANAGEMENT WORKSHOP

R.MAX PETERSON, CHIEF

USDA FOREST SERVICE

MAY 20 - 24, 1985

SMOKE MANAGEMENT

OUR KEY TO MEETING AIR QUALITY GOALS AND RESOURCE MANAGEMENT OBJECTIVES

All of us who work for public or private land management organizations today face serious challenges to the continued use of prescribed fire in resource management activities. These challenges come at a time when our collective use of prescribed fire is increasing. Prescribed fire creates smoke. Unmanaged smoke can result in a variety of adverse air quality impacts.

Air--like soil, water, wildlife and vegetation--is a basic resource. We are each responsible for protecting and enhancing the quality of this basic resource. However, we are also directed to achieve a large number of additional resource management goals and objectives that can potentially conflict with our air resource management responsibilities. Smoke management provides us with the means of protecting the quality of the air resource, while accomplishing management goals and objectives that require the use of prescribed fire.

We have two primary motivators for managing smoke from prescribed fires. First, we have a growing liability problem associated with residual or holdover smoke obscuring visibility on highways. This situation has resulted

in fatalities, personal injury, and property loss. Courts have held the owner of the land liable for damages. The loss of life and disruption of family units are permanent tragedies.

Secondly, the Environmental Protection Agency, in response to Congressional directives and public concern over the quality of air in the United States, has proposed new air quality regulations which could eventually limit prescribed burning practices in many parts of the country. These proposed regulations address visibility impacts in all areas, including Class I areas, as a result of plume blight and regional haze from stationary sources. In addition, EPA has proposed changing the National Ambient Air Quality Standard on particulate matter so that the revised standard will only address the small particulate sizes that cause serious respiratory problems. Smoke from both prescribed fire and wildfire falls into this category.

You need to know about these proposed standards and how they could impact our use of prescribed fire, particularly if we fail to do a superior job of smoke management.

We work in situations where portions of statutes that provide management direction often set the stage for potential conflicts. For example, legislative mandates such as the Wilderness Act and the National Forest Management Act require ecologically sound management that includes a fire use component. In the context of these laws, fire use is viewed as beneficial. Yet, this same fire use can be viewed as potentially detrimental under the visibility and pending regional haze goals of the Clean Air Act. As resource

managers, we need to work together with State and Local government agencies in the difficult task of finding the common ground that allows us to carry out our management responsibilities in a way that meets the intent of the air quality and visibility goals of the Clean Air Act.

Unfortunately, many air quality professionals do not understand the reasons for using prescribed fire or the importance of prescribed fire as an ecologically sound resource management tool. Nor do they realize that we can avoid adverse air quality impacts by properly managing smoke from prescribed fires. We must explain the ecological basis for our use of prescribed fire in our management practices, as well as the trade offs of not using it. We must also be able to explain and demonstrate our ability to manage smoke in an acceptable manner.

We know that fire has historically played a major role in shaping the wildland ecosystems of North America. Smoke, like fire, has been a natural component of our ecosystems for millions of years. Fire and smoke can not be totally eliminated from our wildland ecosystems without serious adverse consequences. For example, when we attempted to protect wildland ecosystems by excluding all fires, we found that we initially reduced the number of wildfires and the area burned. However, over time, fuel loadings increased to the point that we began experiencing a significantly greater number of devastating, high intensity conflagrations. We found that society could not afford the increased costs in terms of loss of life, resources, and improvements, and the increased costs of protection.

We also need to look at the positive side of the picture and recognize that smoke appears to have some beneficial biological aspects. Historically, smoke from wildfires started by lightning and Native Americans obscured visibility for days on end each year in many parts of our country. Some scientists now believe that smoke has several beneficial properties in wildland ecosystems. Preliminary research indicates that smoke acts as a fumigant as it passes through the forest canopy, checking the spread of various insects, bacteria, viruses and other forest pathogens. If we eliminate smoke from wildland ecosystems, we may adversely affect one of natures important checks and balances.

In many parts of the country, prescribed fire is the most cost effective technology available for preventing wildfires. Because we can choose the day, the hour, the location, and the duration of the burn, use of prescribed fire results in far less air quality degradation than wildfire would cause. Use of prescribed fire under the right conditions actually reduces the probability of high intensity wildfires which often occur under adverse air quality conditions.

However, we must be judicious in our use of prescribed fire. We need to continue to find ways to effectively reduce the amount of logging residue we now burn each year. Hopefully, this will occur through improved utilization. Even though we can reduce the large volume of woody residue we now burn, we all manage many fire dependent forest and range land ecosystems that will continue to require the application of fire for plant regeneration and maintenance. Where we use prescribed fire we need to work at reducing the

amount of smoke produced by using more efficient burning practices, burning during periods of good ventilation, and using more mop up to reduce the length of the smoldering phase of the burn.

The designation of Class I areas has added a significant element of complexity to our air resource management job. However, until State regulations require otherwise, the Clean Air Act regulations allow us to use prescribed fire within a Class I area, even if it temporarily obscures visibility. We can also send smoke from a prescribed fire outside of a Class I area through a Class I area. The visibility impairments if any, are temporary, random, infrequent, and usually of a short duration.

Lightning-caused ignitions in a Class I area, burning within an approved prescription, may produce large volumes of smoke during periods of heavy visitor use. Public contacts and informative signing will educate the user and can often reduce visitor complaints. Many informed wilderness visitors view fire and smoke as an integral part of their wilderness experience.

I want to emphasize that our stewardship responsibilities must take us beyond mere compliance with existing laws and regulations. For example, I would suggest avoiding ignition of a prescribed fire that would send smoke through a Class I area during periods of high use, especially on a peak use weekend. I know this places additional pressure on the manager by compressing the number of available days when all factors fit the prescription. However, this kind of give and take also helps us to retain our management options.

Section III
MODEL SELECTION

Smoke Models by Category

Decision Analysis (page # 8)

- Recommended Level of Effort
- Preferred Models

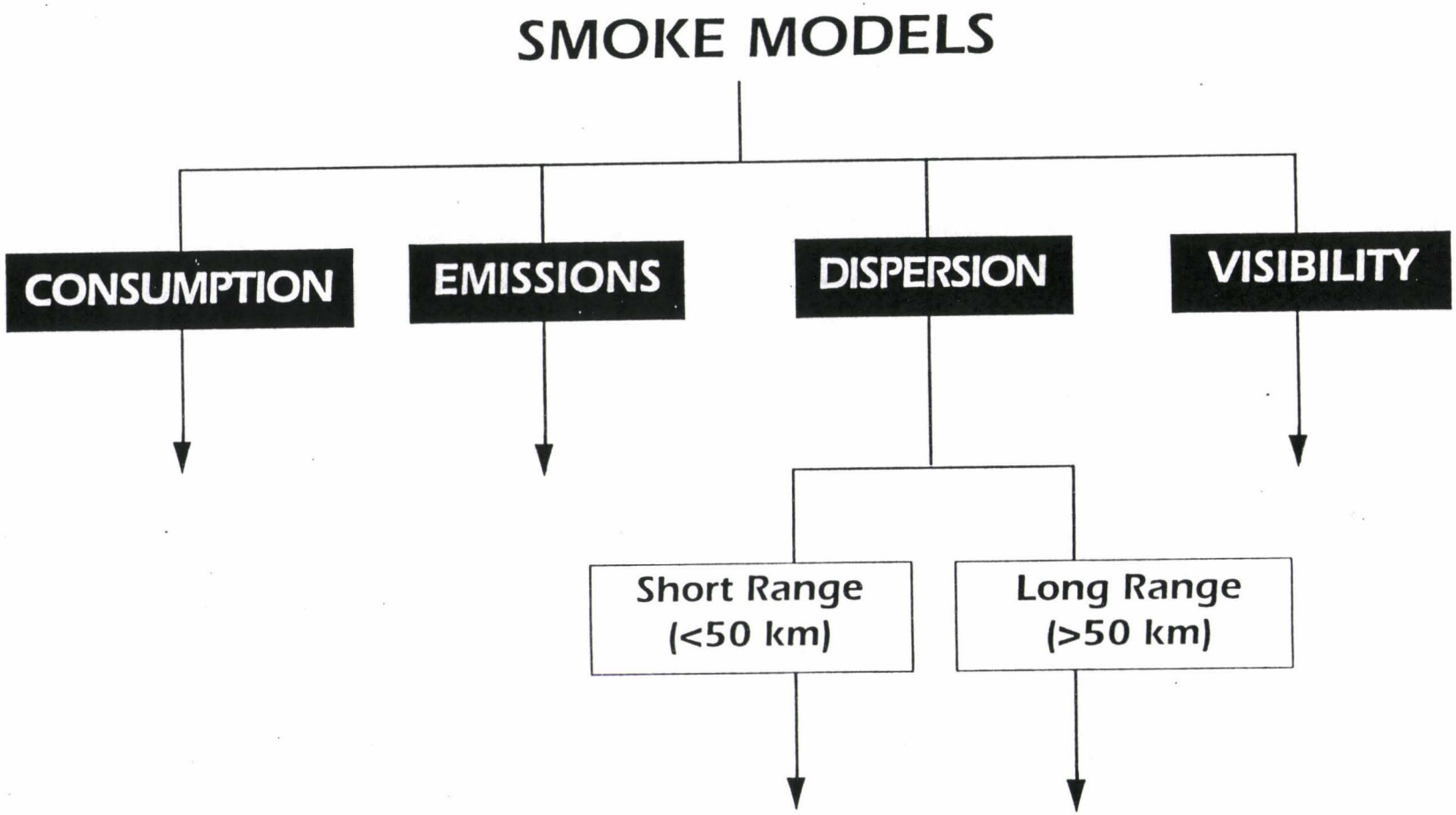
Examples

Smoke Models By Category

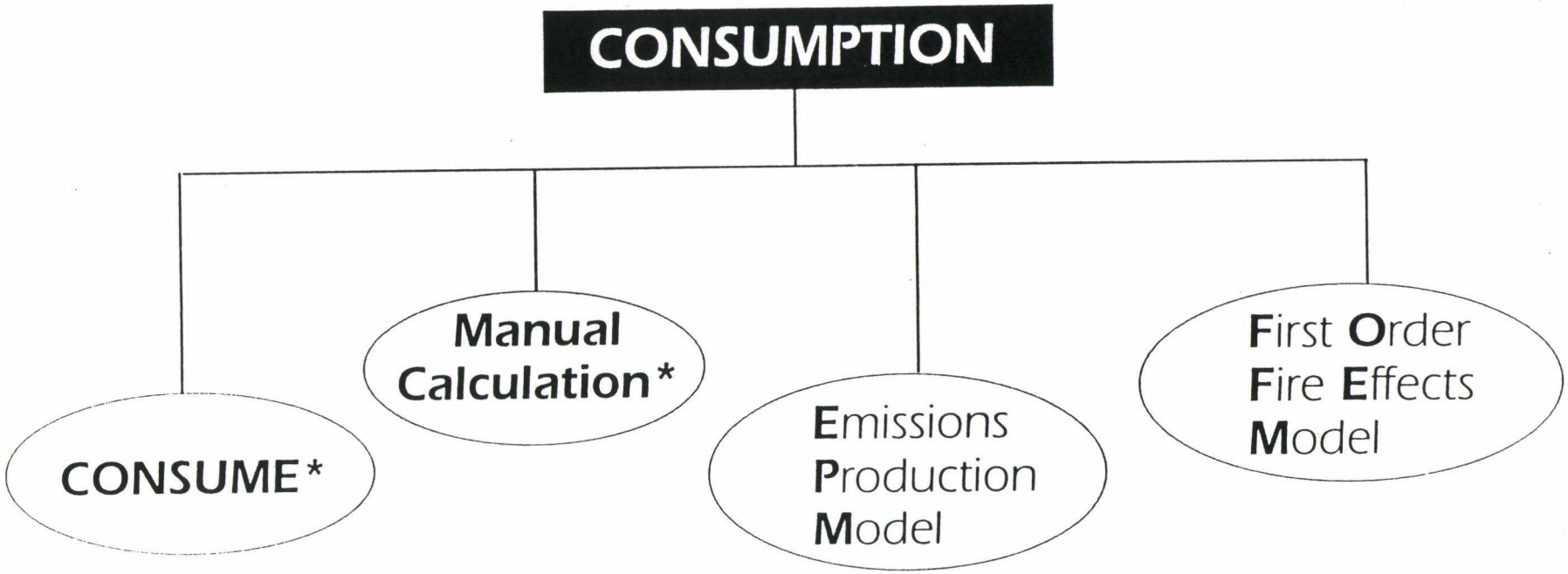
Four Major Categories Differentiated by Function:

- **Consumption Models:** Used to predict woody fuel consumption
- **Emissions Models:** Used to predict pollutant emission rates
- **Dispersion Models:** Used to predict air concentrations and/or surface deposition rates
- **Visibility Models:** Used to predict visibility impairment; coupled with dispersion model algorithms

Smoke Models by Category *(cont.)*

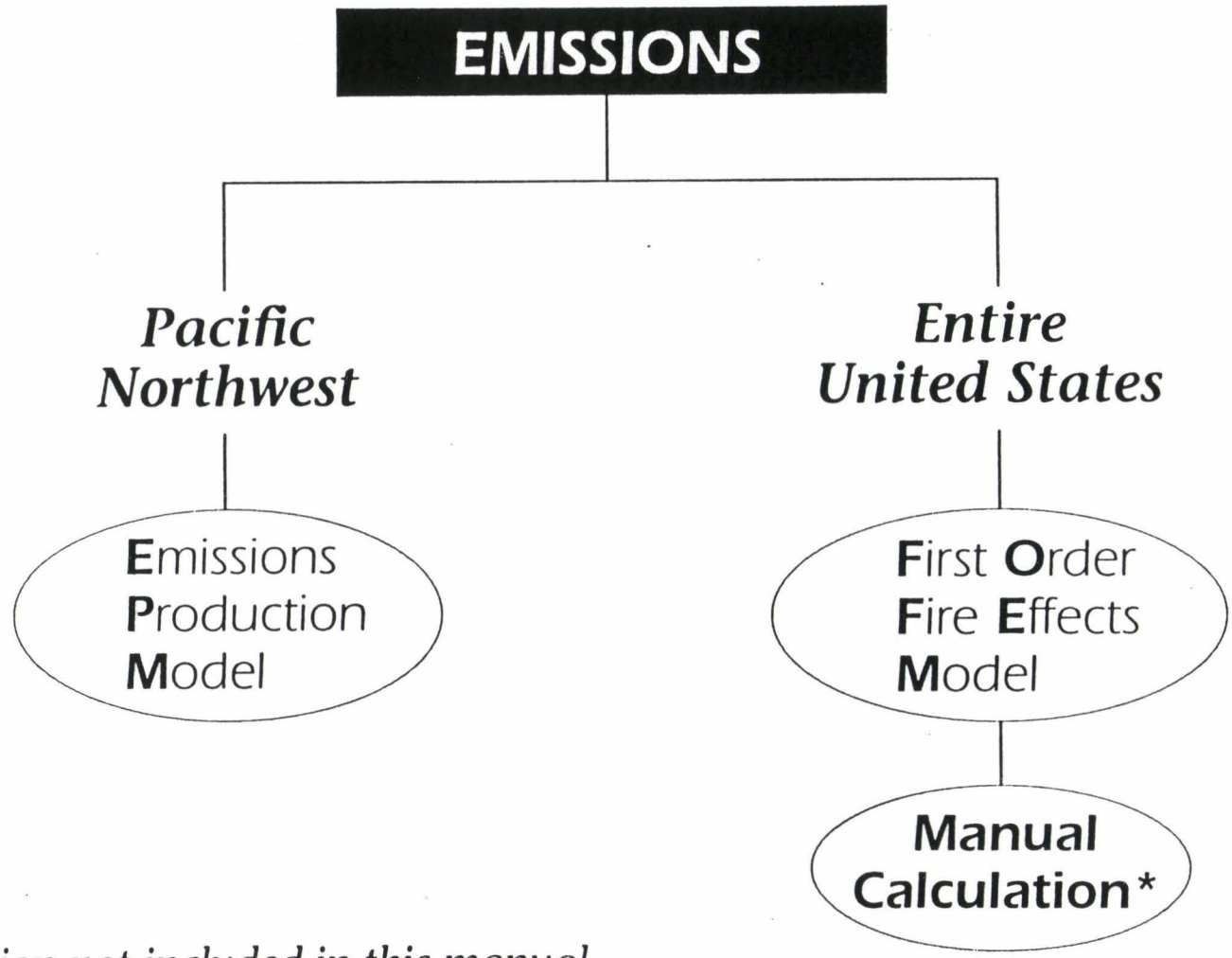


Smoke Models by Category *(cont.)*



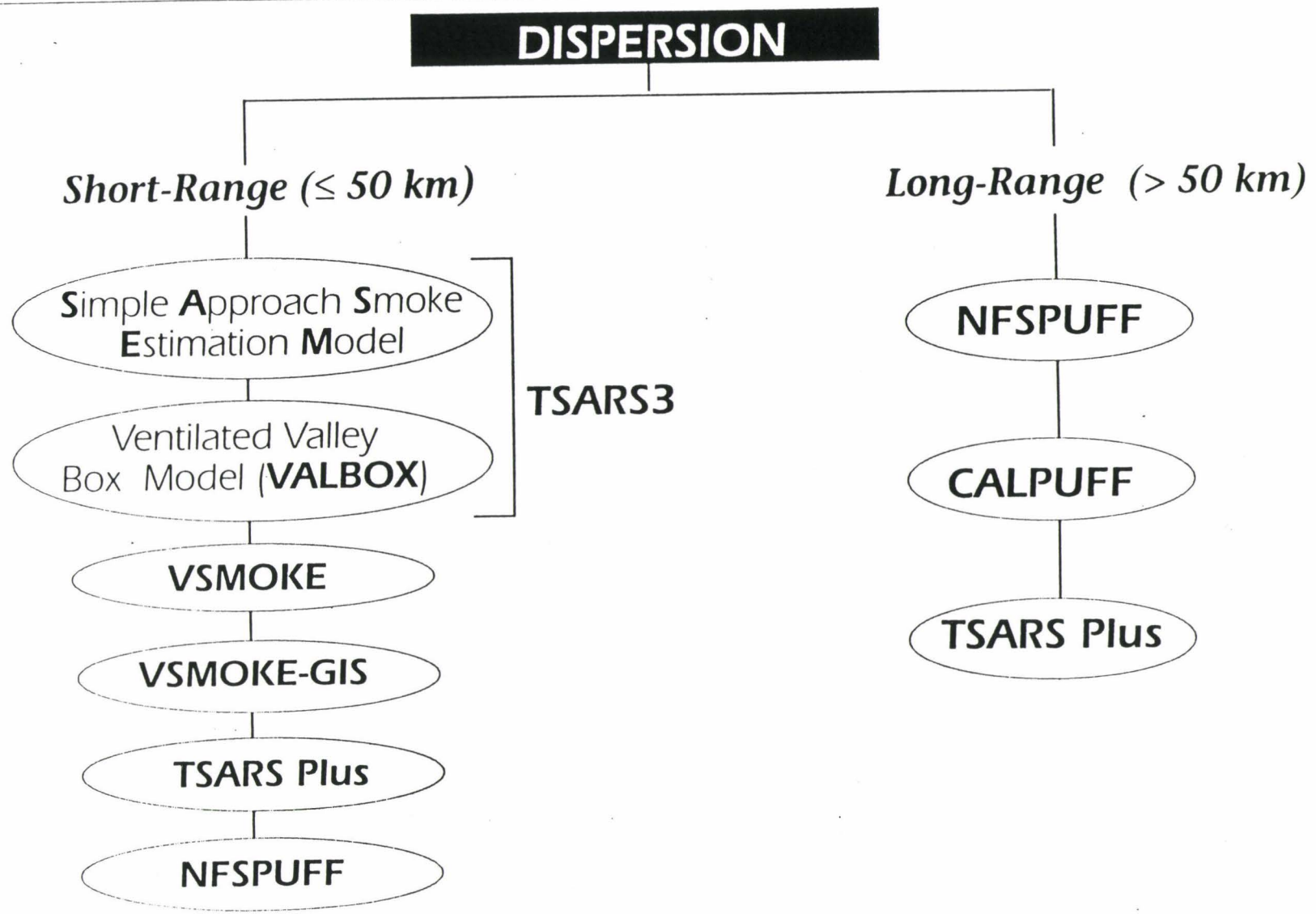
* *Description not included in this manual.*

Smoke Models by Category *(cont.)*

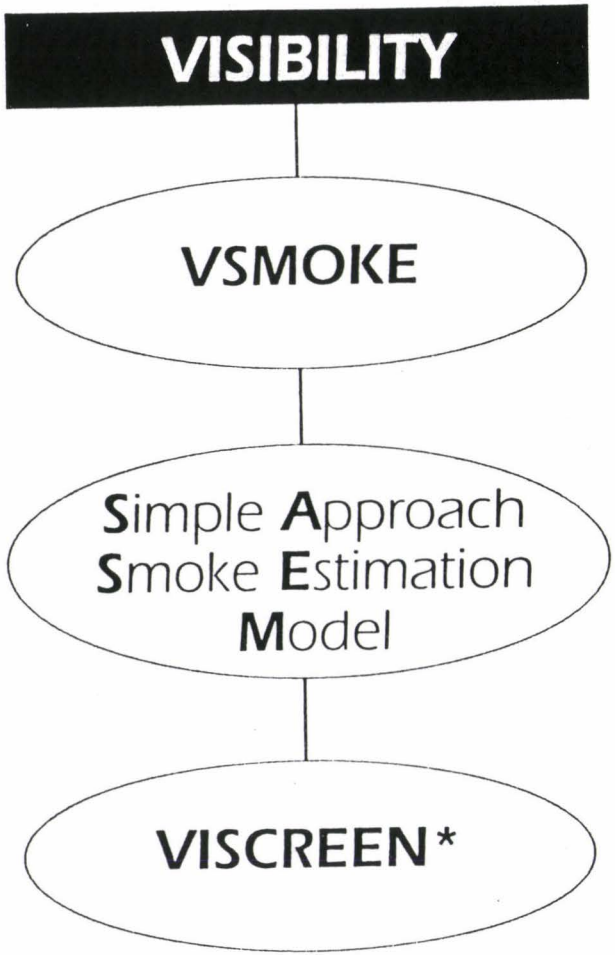


* *Description not included in this manual.*

Smoke Models by Category *(cont.)*



Smoke Models by Category *(cont.)*



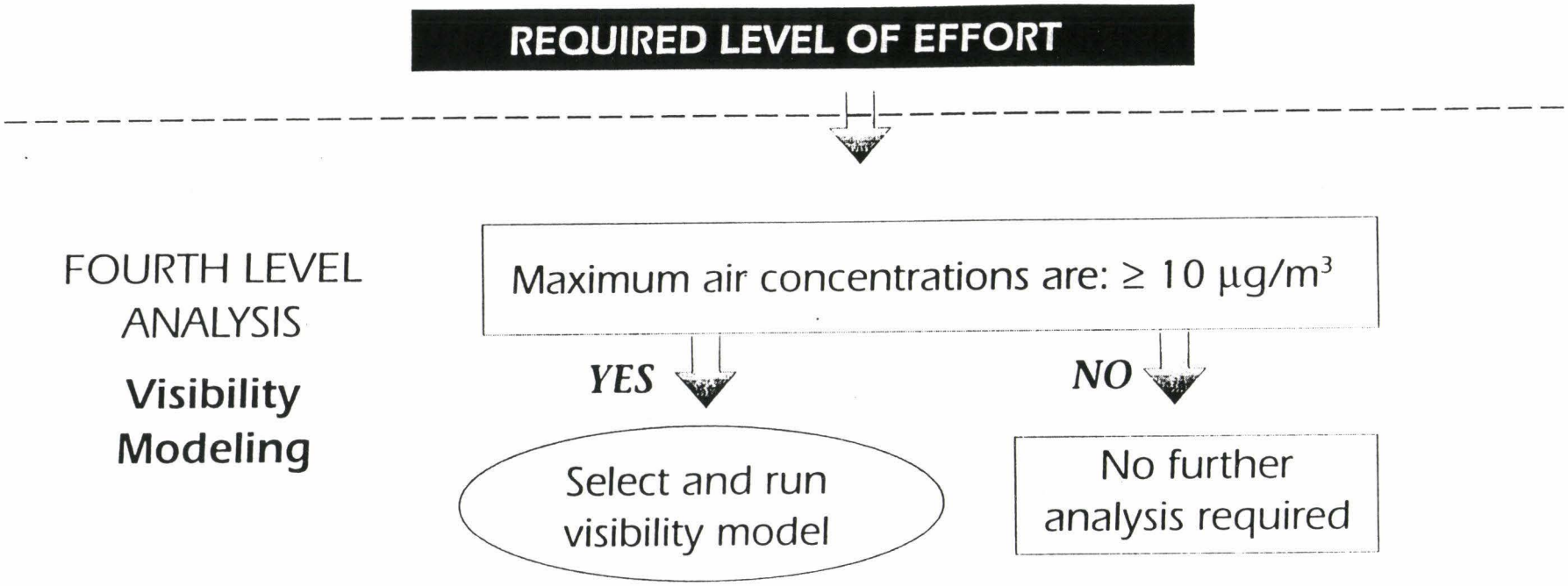
* *Description not included in this manual.*

Decision Analysis – SMOKE MGT. MODELS

The criteria used to determine the recommended level of effort are:

- Unit size and number of units
- Fuel loading
- Distance to sensitive areas
- Emissions
- Terrain
- Analysis required by states

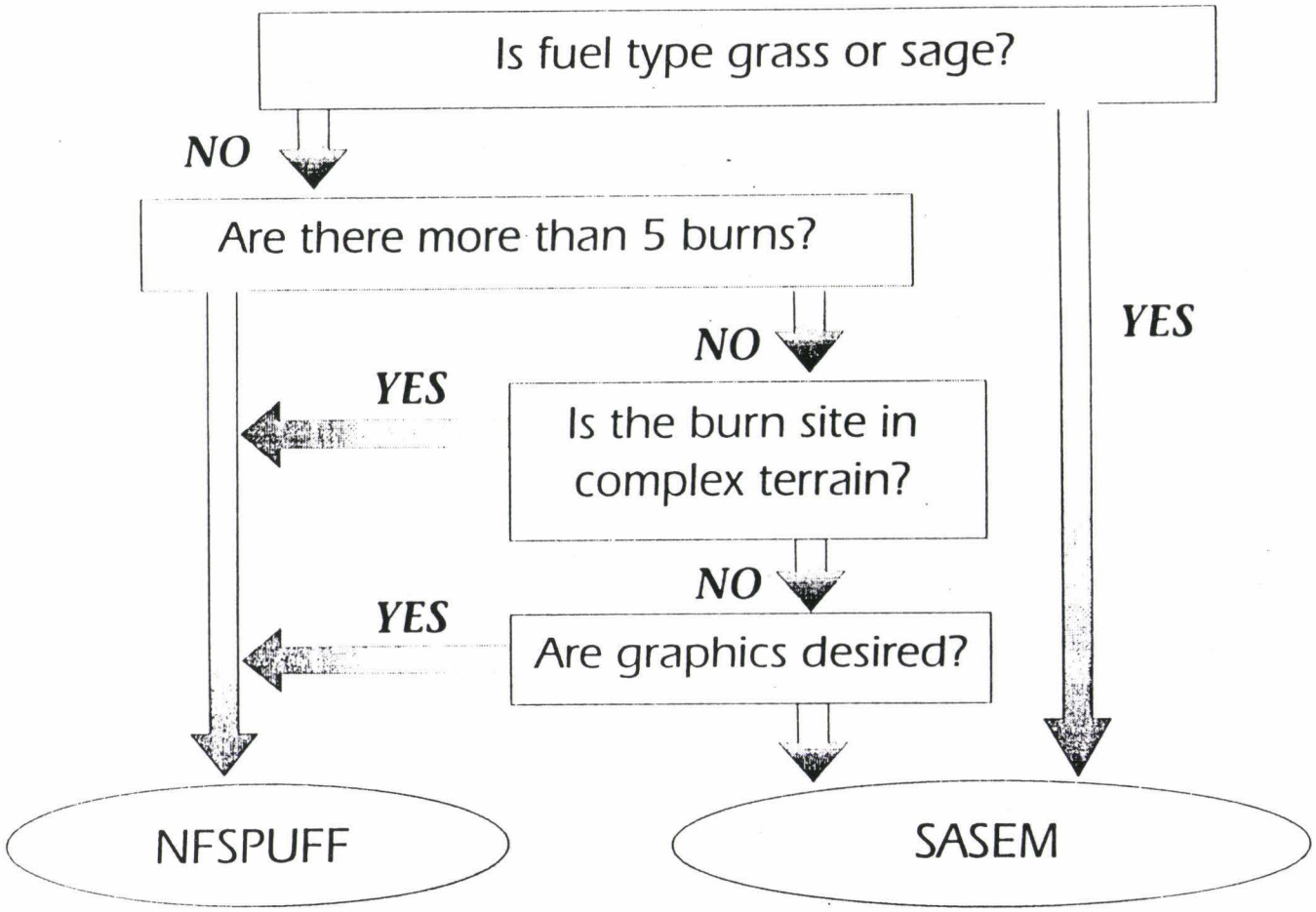
Decision Analysis *(cont.)*



PREFERRED MODELS – EMISSIONS

Estimate Emissions Using
First Order Fire Effects Model (FOFEM)

PREFERRED MODELS – DISPERSION

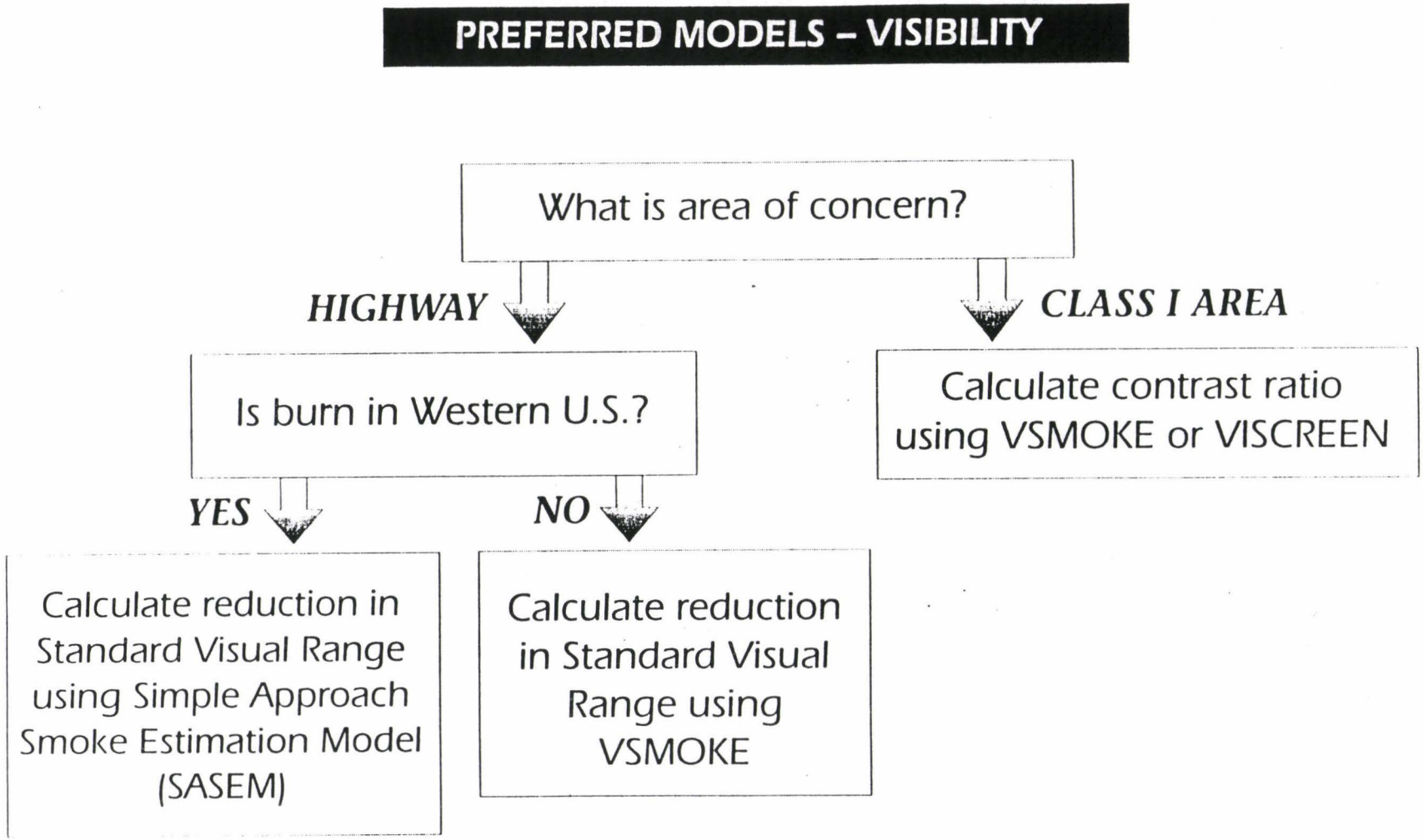


PREFERRED MODELS – DISPERSION

Exceptions:

- If smoke plume is likely to be trapped in valleys, consider using VALBOX (in TSARS3) or CITPUFF (in TSARSPlus).
- When conducting regional or forest-wide analyses, consider using CALPUFF.
- In eastern or midwestern United States, consider using VSMOKE or VSMOKE-GIS.

Decision Analysis *(cont.)*


PREFERRED MODELS – VISIBILITY
What is area of concern?
HIGHWAY
CLASS I AREA
Is burn in Western U.S.?
Calculate contrast ratio using VSMOKE or VISCREEN
YES
NO
Calculate reduction in Standard Visual Range using Simple Approach Smoke Estimation Model (SASEM)
Calculate reduction in Standard Visual Range using VSMOKE

7'

F

US EPA Carol Browner

statement to Federal Land

Managers 11-22-97

" RX Fire and Air Quality

can mix (be compatible) "

Browner Says Fire and Air Quality Can Mix (November 22, 1997, National Association of State Foresters) - The Environmental Protection Agency's (EPA) new air quality standards for ozone and particulate matter will not prevent the use of prescribed fire as a forest management tool, said EPA Administrator Carol Browner before a September 30 hearing of the House Resources Committee. Browner further explained that her agency's mission under the Clean Air Act is to protect public health. "We would never allow our air standards to inhibit sound forest management practices designed to reduce the danger of [catastrophic] wildfires to humans and to property," she said. Florida State Forester Earl Peterson joined Browner, as well as USDA Secretary Dan Glickman and Interior Secretary Bruce Babbitt, in testifying before the House Committee. "We have two choices in managing our wildlands [in Florida]," explained Peterson, "exclude fire until the system is overloaded and disaster strikes, or manage both wildfire and prescribed fire to balance the system." Peterson's agency manages over 1 million acres of state land, much of which exists within a fire-dependent ecosystem. A hundred year history of suppressing forest fires has led to unprecedented changes in the nation's forest ecosystems, including crowded stand densities; greater susceptibility to insect and disease infestations; loss of historic species and habitat; and dangerous levels of fuel loading. Fed by thick ladders of vegetative fuel, wildfires now burn hotter, higher, and longer, causing long-term damage to essential natural resources. Some lawmakers, primarily from the West, would prefer that forest managers treat these at-risk forests, particularly those in federal ownership, with mechanical thinning (logging) rather than burning. Prior to the September hearing, these legislators based part of their argument on the claim that prescribed fines could lead to violations of the new EPA air standards. "At a time when the risk of catastrophic fire is so severe, I question our ability to increase burning without first reducing the heavy fuels in our overcrowded forests," said Rep. Helen Chenoweth (R - ID) who presided over the panel's hearing. Chenoweth and Rep. Bob Smith (R - OR) have introduced separate legislation which would use thinning to reduce the threat of fire to public safety (H.R. 2458) and improve forest health (H.R. 2515). Secretary Glickman in his testimony emphasized the need to use a variety of tools, including land management planning, thinning, and prescribed burning, to address fire concerns on public lands. Forest Service Director of Fire and Aviation Management Mary Jo Lavin further explained that, while prior thinning may be needed on some of the 40 million acres currently identified as in need of treatment, her agency hopes to move toward using naturally occurring fire as their primary means of reducing fire risk. The EPA will use a "comprehensive network" of monitors to obtain data on whether areas are attaining the new air standards, which were establish by final rule July 18. According to Browner, data from days when a wildfire occurs can be excluded from the overall compliance database. When pressed by Rep. Bob Schaffer (R-CO) on whether data from prescribed burn days would also be excluded from the attainment decision, Browner said that such exclusion should not be necessary if burns are conducted according to proper guidelines. EPA has established an interagency work group to further elaborate a "national wildland fire-air quality policy." The group includes fire and air quality experts from USDA, the Interior Department, the Defense Department, and state and local air quality agencies. Colorado State Forester Jim Hubbard represents NASF on that committee. EPA expects to issue a formal policy early next year in conjunction with their guidance on implementation of the new fine particle standard.

Appendix F

EPA

INTERIM AIR QUALITY POLICY ON WILDLAND AND PRESCRIBED FIRES

April 23, 1998

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Background on the Role of Fire

What Wildland Fire Conditions Minimize Emissions and Hazardous Air Pollutants and Can Land Management Goals Still Be Met?

Air Monitoring for Wildland Fire Operations

Emissions Inventories for SIP Development

Estimating Natural Emissions From Wildland and Prescribed Fire

I. PURPOSE

This policy statement has been prepared in response to plans by some Federal, tribal and State wildland owners/managers to significantly increase the use of wildland and prescribed fires to achieve resource benefits in the wildlands.[1] Many wildland ecosystems are considered to be unhealthy as a result of past management strategies. The absence of fire effects has allowed plant species (e.g., trees and shrubs) that would normally be eliminated by fires to proliferate, vegetation to become dense and insect infestations to go unchecked. Wildland owners/managers plan to significantly increase their use of fires to correct these unhealthy conditions and to reduce the risk of wildfires to public and fire fighter safety. The largest increases are expected mainly on Federal lands in western States in ecosystems where fires would naturally occur every few years (35 years or less) if not suppressed. Fire has continued to be a management tool used by many public and private wildland owners/managers in the southeastern States. However, Federal land managers in the southeast also plan to significantly increase their use of fire above current annual levels.

This policy statement integrates two public policy goals, (1) to allow fire to function, as nearly as possible, in its natural role in maintaining healthy wildland ecosystems, and (2) to protect public health and welfare by mitigating the impacts of air pollutant emissions on air quality and visibility. This document provides guidance on mitigating air pollution impacts caused by fires in the wildlands and the wildland/urban interface. It identifies the responsibilities of wildland owners/managers and State/tribal air quality managers to work together to coordinate fire activities, minimize air pollutant emissions, manage smoke from wildland and prescribed fires managed for resource benefits, and establish emergency action programs to mitigate the unavoidable impacts on the public. This policy is not intended to limit opportunities by private wildland owners/ managers to use fire so that burning can be increased on publicly owned wildlands. Thoughtful use of fire by private, public and Indian wildland owners/managers within SMP's is promoted to maintain healthy wildland ecosystems. Neither is this policy intended to

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[1]This document contains EPA policy and, therefore, does not establish or affect legal rights or obligations. It does not establish a binding norm and it is not finally determinative of the issues addressed. In applying this policy in any particular case, the EPA will consider its applicability to the specific facts of that case, the underlying validity of the interpretations set forth in this memorandum, and any other relevant considerations, including any that may be required under applicable law and regulations.

imply that States/tribes should relax existing SMP's or limit a State's/tribe's ability to regulate fires managed for resource benefits.

The EPA used a deliberative process involving a multi-stakeholder workgroup to develop recommendations for this policy. The workgroup did not reach consensus on all of the issues raised. The EPA addressed all of the recommendations and concerns raised by the stakeholders to the extent possible. The multi-stakeholder workgroup also produced several "white papers" on a number of topics previously identified in earlier drafts of the policy as Appendices to the policy. These papers will be published as a separate document and can also be found on EPA's TTN2000 website:

http://134.67.104.12/html/o3pmrh/pbissu.htm, and on the Western States Air Resources Council (WESTAR) website: http://www.westar.org/proj_frame.html. A list of these papers is provided in the Table of Contents.

II. SCOPE AND APPLICABILITY

The EPA does not directly regulate the use of fire within a State or on Indian lands. The EPA's authority is to enforce the requirements of the CAA. The CAA requires States and tribes to attain and maintain the NAAQS adopted to protect public health and welfare. This policy recommends that States/tribes implement SMP's to mitigate the public health and welfare impacts of fires managed for resource benefits. While SMP's will also mitigate nuisance smoke intrusions, nuisance issues have been left for the individual air quality agencies to address.

This policy applies to all wildland and prescribed fires managed to achieve resource benefits on public, Indian and privately owned wildlands, regardless of the cause of ignition (e.g., lightning, arson, accidental, land management decision, etc.) or purpose of the fire (e.g., natural, resource management, hazard reduction, etc.).

Federal land management agencies sometimes manage naturally ignited fires to achieve resource benefits. Planning for naturally ignited fires is obviously limited, but the agencies require fire management plans to be included in land use plans for an area before a naturally ignited fire can be managed for resource benefits. Fires ignited in areas without fire management plans are

unwanted or wildfires. The interface between this policy and the Natural Events Policy[2] regarding ambient PM_{10} concentrations caused by wildfires is addressed in section VII.

This policy does not apply to other open burning activities, such as burning at residential, commercial or industrial sites; open burning of land clearing waste or construction debris. It also does not apply to open burning of agricultural waste, crop residue or land in the USDA Conservation Reserve Program. The EPA is working with the USDA Agriculture Air Quality Task Force to develop equitable policies for emissions from activities that could be classified as agricultural burning.

This policy addresses the impacts of air pollutant emissions from fires managed for resource benefits on public health and welfare. The primary indicators of public health impacts used are ambient air quality impacts above the NAAQS for fine particles with an aerodynamic diameter less than or equal to a nominal 2.5 micrometers ($PM_{2.5}$), and particles with an aerodynamic diameter less than or equal to a nominal 10 micrometers (PM_{10}). There are both 24-hour (daily) and annual NAAQS for $PM_{2.5}$ and PM_{10}. Emissions of nitrogen oxides (NO_x), VOC, and CO from fires can also impact the NAAQS for NO_2, O_3, and CO. However, the actions required to reduce VOC and CO emissions are the same as those recommended in this document to mitigate impacts on the $PM_{2.5}$, and PM_{10} NAAQS. Emissions of NO_x, on the other hand, can increase under some of the burning conditions used to decrease emissions of other pollutants.

The effects of fire emissions on the public welfare aspects of the NAAQS for PM are addressed in terms of visibility impairment and regional haze. The policy also addresses the treatment of fire emissions to meet other CAA requirements, such as prevention of significant deterioration (PSD) and conformity with SIP's or TIP's.

III. BACKGROUND

A. The Role of Fire in the Wildlands

The role of fire in North American ecosystems has been undergoing change since people began to play a more active role in managing their natural resources. Native Americans actively used fire to alter vegetative patterns, to ease travel, or for hunting purposes. Prior to European

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[2]See memorandum from Mary D. Nichols, Assistant Administrator for Air and Radiation to EPA Regional Offices titled Areas Affected by PM_{10} Natural Events, May 30, 1996.

settlement, fire played a natural role as a necessary disturbance phenomena, keeping fuel density in check as well as insects and the diseases they carry, thereby maintaining North American wildlands in a healthy state. After European settlement and the introduction of grazing herds of cattle and sheep, and the practice of fire suppression, public land management agencies have recognized that not allowing fire to play its natural role in our wildlands has had unintended negative effects. When forests and grasslands are not allowed to burn naturally (lighting serving as the principal source of ignition) the result can be heavy accumulation of dead vegetation which provides fuel for unwanted fires (wildfires). Because of this unhealthy build-up of fuels, the risk of catastrophic wildfires is much greater as evidenced by several recent fires in our national forests and other publicly owned lands. These fires put firefighters and the general public in danger while destroying millions of acres of forests and costing millions of dollars to suppress. The lack of fire also has unintended ecological effects, leading to the loss of habitat for rare species and the decline of ecosystems. Fire exclusion can lead to an alteration in natural community types, and an important loss of biodiversity. Many plant and animal species are on the decline because they exist in fire-dependent habitats that haven't burned in decades. This situation has led to a rethinking of Federal land management and fire management policy.

B. <u>Changes in Fire Management Policy</u>

In 1995, a Federal Wildland Fire Management Policy and Program Review was conducted in response to the unhealthy condition of our public wildlands, and the increase in unplanned fires that occurred in 1987, 1988, 1992 and again in 1994. As a result of this review, the five principal Federal fire/land management agencies [the Forest Service (FS) under the Department of Agriculture; and the Bureau of Land Management (BLM), National Park Service (NPS), Fish and Wildlife Service (FWS), and the Bureau of Indian Affairs (BIA) under the DOI] agreed on need for several changes to existing fire/land management practices. Their recommendations include the reintroduction of fire (allowing it to play its natural role) into Federal land management programs in "an ongoing and systematic manner, consistent with public health and environmental quality considerations." The goals of this change in land management policy are to reduce unnatural fuel densities that contribute to increasing unplanned fire hazards, and to restore wildland ecosystems to their healthy natural states. The Federal agencies previously mentioned

began increasing the use of fire in their most vulnerable wildlands in 1997. Annual treatment targets for all Federal land management agencies will be increased to more than 5 million acres per year by 2005.

C. Air Quality Considerations

Burning wildland vegetation causes emissions of many different chemical compounds such as small particles, No_x, CO and organic compounds. The components and quantity of emissions depends in part on the types of fuel burned, its moisture content, and the temperature of combustion. Complex organic materials may be absorbed into or onto condensed smoke particles. Tests indicate that, on average, 90 percent of smoke particles from wildland and prescribed fires are PM_{10}, and 70 percent are $PM_{2.5}$.

Historically, EPA's NAAQS for PM have tended to focus emission control efforts on "coarse" particles--those larger than $PM_{2.5}$. Before 1987, EPA's PM standards focused on "Total Suspended Particles," including particles as large as 100 micrometers in diameter. The EPA revised the standards in 1987 to focus control on PM_{10} in response to new science showing that it was the smaller particles capable of penetrating deeply into the lungs that were associated with the most adverse health effects. For comparison, a human hair is about 70 micrometers in diameter.

The most recent review of health studies focused attention on the need to better address the "fine" fraction particles - $PM_{2.5}$. These more recent studies provide consistent and coherent, "evidence that serious health effects (mortality, exacerbation of chronic disease, increased hospital admissions, etc.) are associated with exposures to ambient levels of PM found in contemporary urban airsheds even at concentrations below current U. S. PM standards" (Criteria Document-U.S. EPA 1996a, p. 13-1). PM concentrations currently found in many communities are associated with adverse health effects in the general population, including increased mortality and morbidity, altered lung function, increased respiratory symptoms, aggravated respiratory and cardiovascular disease. Sensitive sub-populations, such as children, the aged and those with existing cardiopulmonary or infectious respiratory disease, may experience effects at lower levels of PM than the general population, and the severity of effects might be greater. These studies are the basis for the July, 1997 promulgation of new NAAQS for $PM_{2.5}$, which are designed to

protect public health, with an adequate margin of safety.

Fine particles are also a major cause of visibility impairment in such places as national parks that are valued for their scenic views and recreation.

D. Visibility Impairment

Visibility conditions are affected by scattering and absorption of light by particles and gases. The fine particles most responsible for visibility impairment are sulfates, nitrates, organic compounds, soot and soil dust. Fine particles are more efficient per unit mass than coarse particles at scattering light. Light scattering efficiencies also go up as humidity rises, due to water adsorption on fine particles, which allow the particles to grow to sizes comparable to the wavelength of light. There are distinct regional variations in visibility between eastern and western States, due, to generally higher relative humidities in the East. Naturally occurring visual range in the East may be between 105 to 190 kilometers, while natural visual range in the West is between 190 to 270 kilometers.

Visibility is an important public welfare consideration because of its significance to enjoyment of daily activities in all parts of the country. Protection of visibility as a public welfare consideration is addressed nationally through the secondary PM NAAQS which are equivalent to the primary PM NAAQS. Visibility protection is particularly important in the 156 mandatory Class I Federal areas, "Areas of Great Scenic Importance," and is addressed for these areas by the special provisions of Sections 169A and 169 B of the CAA.

The effects of smoke from wildland and prescribed fires on air quality will be discussed throughout this document. The term air quality, as used in this document, refers to ambient concentrations of pollutants (primarily PM in locations accessible to the general public), and, where applicable, to impacts on visibility in mandatory Class I Federal areas. Thus, wherever this document discusses the need for wildland owners/managers to consider the impacts of their actions on air quality, this may include consideration of the effects of their actions on visibility in mandatory Class I Federal areas.

Existing requirements to consider effects on visibility which are reasonably attributable to a single nearby source or small number of sources are contained in the regulations published by EPA in 1980 at 40 CFR 51.300 (Protection of Visibility). Additional regulations are currently

being developed to address impairment of visibility that is more regional in its character and origins ("regional haze"). This interim policy may be revised to be made consistent with the regional haze rules when they become final.

Please refer to the white paper, "Background on the Role of Fire," for more complete background information. See Section I to obtain a copy.

IV. DESCRIPTION OF POLICY

The EPA's policy regarding wildland and prescribed fires managed for resource benefits is that owners/managers of public, private and Indian wildlands should collaborate with State/tribal air quality managers (air regulators) to achieve their goals of: (1) allowing fire to function in its natural role in the wildlands, and (2) protecting public health and welfare by minimizing smoke impacts. The EPA urges air quality managers to participate in public land use planning activities which involve selecting appropriate resource management treatments, including the use of fire, and to help identify air quality criteria for fire management plans. Air quality managers are urged to help evaluate the potential impacts of alternative resource treatments and assure that air quality concerns (also visibility and regional haze concerns, where appropriate) are adequately addressed in the public land use planning process. They are urged to solicit information from private and Indian wildland owners/managers on plans to use fire for resource management, to encourage them to consider appropriate alternative treatments, and to assist them in evaluating the potential air quality impacts of alternatives to meet particular management objectives.

Wildland owners/managers are urged to: (1) notify air quality managers of plans to significantly increase their future use of fire for resource management, (2) consider the air quality impacts of fires and take appropriate steps to mitigate those impacts, (3) consider appropriate alternative treatments, (4) and participate in the development and implementation of State/tribal SMP's.

The EPA will allow States/tribes flexibility in their approach to regulating fires managed for resource benefits. They are not required to change their existing fire regulations if those regulations adequately protect air quality. However, there are incentives for States/tribes to certify to EPA that they have adopted and are implementing a SMP that includes the basic components identified in this policy. The main incentive is that, as long as fires do not cause or

significantly contribute to daily or annual PM2.5 and PM10 NAAQS violations, States/tribes may allow participation by burners in the basic SMP to be voluntary and the SMP does not have to be adopted into the SIP. Another incentive is the commitment by EPA to use its discretion not to redesignate an area as nonattainment when fires cause or significantly contribute (see section VII.B.) to PM NAAQS violations, if the State/tribe required those fires to be conducted within a basic SMP. Rather, if fires cause or significantly contribute violations, States/tribes will be required to review the adequacy of the SMP, in cooperation with wildland owners/managers, and make appropriate improvements.

If States/tribes do not certify that a basic SMP is being implemented, no special consideration will be given to PM violations attributed to fires managed for resource benefits. Rather, EPA will call for a SIP revision to incorporate a basic SMP and/or will notify the governor of the State or the tribal government that the area should be redesignated as nonattainment. The SMP adopted in response to the SIP/TIP call must require mandatory participation for greater than de minimis fires, and must be adopted into the SIP/TIP so that it is Federally enforceable. Also, the SIP/TIP must meet all other CAA requirements applicable to nonattainment areas.

Fire data requirements for SIP's/TIP's are addressed in section VIII of this policy. Guidance for meeting CAA requirements to show conformity of Federal fire activities with SIP's, to address visibility/regional haze impacts, and to address prevention of significant deterioration of air quality are addressed in section IX.

The following are guiding principles for implementing this policy:

- Air quality and visibility impacts from fires managed for resource benefits should be treated equitably with other source impacts.
- Land and vegetation management practices should be promoted that are best for wildland ecosystems, yet protect public health and avoid visibility impairment.
- States/tribes should foster collaborative relationships among wildland owners/managers, air quality managers and the public to develop and implement SMP's.
- States/tribes will be allowed the flexibility (prior to measuring violations of the $PM_{2.5}$ or PM_{10} NAAQS attributable to fires managed for resource benefits) to decide when a SMP

is needed and how the program will be designed to prevent adverse air quality impacts. This does not preclude wildland owners/managers from including smoke management components in burn plans for fires they conduct in the absence of an applicable State/tribal program.

- All parties (wildland owners/managers, air quality managers and the public) are expected to act in good faith and will be held accountable for implementing their respective parts of fire and SMP's.

V. COLLABORATION AMONG LAND AND AIR QUALITY MANAGERS

Wildland owners/managers and air quality managers can overcome the barriers to achieving their goals of: (1) returning fire to its natural role in the wildlands and (2) protecting air quality and visibility, by working together toward those ends. Wildland owners/managers should notify State/tribal air quality managers if they are planning to significantly increase the use of fire to manage wildland resources. Air quality managers with Federal/State/local public wildlands within their jurisdictions have a responsibility to participate in the public planning processes conducted for the management of those publicly owned lands. To arrive at the best choice of resource treatments and response to fire, it is essential that the air quality impacts of planned land management activities are adequately addressed. Air quality managers, by participating in the public land use planning process, can help select the scope of land uses; help evaluate alternative management tools and help identify when fire is appropriate; and review projected air quality and visibility impacts. Air quality managers should also consult with private wildland owners/managers to determine long-range resource management objectives and help them evaluate the applicability of alternative treatments based on air quality and visibility considerations.

Wildland owners/managers also have a responsibility to participate with the other stakeholders and State/tribal air quality managers in developing rules and SMP's for fires managed for resource benefits. Air quality managers that intend to develop or revise regulations, plans or policies applicable to fires should solicit the early participation of all affected wildland owners/managers in making those revisions.

A. Land and Vegetation Management

Wildlands are managed by Federal, State and local public agencies (referred to in this document as public land management agencies); tribal and BIA authorities; and private land owners. The goals of public land management agencies vary, but are generally to develop, maintain and enhance wildlife habitat; protect endangered plant and animal species; preserve and protect cultural resources, scenic vistas and wilderness; provide for recreation; and to sustain production of natural resources. The goals of private wildland owners/managers may be sustained production of natural resources, preservation of wildlife habitat, improved grazing conditions, etc. The goals of tribal wildland owners/managers are generally similar to public land management agency goals, but may also include aspects of private land owners. Another common goal of all wildland owners/managers is to minimize the potential for catastrophic wildfires that could result from heavy accumulations of vegetative fuels.

1. Alternative Treatments

Wildland owners/managers may have an array of tools, including fire, that can be used to accomplish land use plans, depending on the resource benefits to be achieved. Several factors should be considered when selecting appropriate treatments. Those factors include the costs of treatment, the environmental impacts (e.g., air and water quality, soils, wildlife, etc.), and whether fire must be used to meet management objectives. The best combination of treatments are those that meet management goals with the most favorable environmental impacts at the most reasonable costs.

a. Utilization and mechanical treatments

Mechanical treatments may be appropriate tools when management objectives are to reduce fuel density to reduce a wildfire hazard, or to remove logging waste materials (slash) to prepare a site for replanting or natural regeneration. On-site chipping or crushing of woody material, removal of slash for off-site burning or biomass utilization, whole tree harvesting, and yarding (pulling out) of unmerchantable material may accomplish these goals. Mechanical treatments are normally limited to accessible areas, terrain that is not excessively rough, slopes of 40 percent or less, sites that are not wet, areas not designated as national parks or wilderness, areas not protected for threatened and endangered species and areas without cultural or paleological resources.

b. **Chemical treatments**

When the management objective is to preclude, reduce or remove live vegetation and/or specific plant species from a site, chemical treatments may be appropriate tools. Other potential environmental impacts caused by applying chemicals must also be considered, however.

c. **Fire treatments**

Fire is one of the basic tools relied upon by wildland owners/managers to achieve a myriad of management objectives in fire dependent ecosystems. Most North American plant communities evolved with recurring fire and, therefore, are dependent on recurring fire for maintenance. The natural fire return interval may vary from 1-2 years for prairies, 3-7 years for some long-needle pine species, 30-50 years for species such as California chaparral, and over one hundred years for species such as lodgepole pine and coastal Douglas-fir. When one management objective is to maintain a fire dependent ecosystem the effects of fire cannot be duplicated by other tools. In such cases, fire may be the preferred management tool even when other treatments may be equally effective for meeting other objectives. Fire can also be used to reduce heavy fuel loads and prevent catastrophic wildfires.

When fire is the chosen management tool, a combination of treatment methods may be the best approach to achieving the desired resource benefits with minimum air quality impacts. Combinations of treatments may include mechanically pretreating an area to thin the fuel load prior to the use of fire.

2. Role of Federal Land Managers (FLM's)

The major Federal agencies with land management responsibilities include the USDA FS, the DOI NPS, and FWS, BLM, and BIA. These agencies manage national parks, forests, monuments, wilderness areas, prairie grasslands, sea shores, Indian lands, wildlife refuges, etc. The Department of Defense and Department of Energy also manage millions of acres of Federal land at military bases, training centers and for other purposes.

a. **Federal land use and fire management planning**

Federal land use planning is an open process for setting land use and management goals and objectives. The planning process is designed for public participation, and must comply with NEPA. State/tribal air quality managers are given the opportunity to participate in land use

planning as part of normal intergovernmental consultation procedures. It is important for air quality managers to participate in public land use planning decisions to ensure that air quality concerns are adequately addressed. Through the public participation process, issues are identified and alternatives are discussed regarding methods for implementing land management activities such as trail building, improvement of wildlife habitat, timber harvesting, use of fire, etc. The environmental impacts of these activities are analyzed including, among other things, impacts on cultural resources, wildlife, vegetation, soils, riparian areas, wetlands, water quality, air quality, and visibility. Consideration of the air quality impacts of land management activities is essential to arriving at the best choice of treatments and response to fire.

Two or more levels of land use planning are conducted by FLM's to achieve management goals. First, broad scale and long-range land use plans must be developed for administrative units (e.g., forests, parks, refuges, sanctuaries, etc.). The land use plan identifies the scope of actions and goals for the lands and resources administered, and typically covers a 10 to 15-year period.

In addition to land use plans, there are other shorter term (typically 1-5 years) planning efforts where decisions are made concerning specific activities and programs, including the use of fire to achieve resource benefits. These may include programmatic plans, such as FMP's, or specific project plans.

The FMP's are strategic plans that define how wildland and prescribed fires will be managed to meet land use objectives. The FMP's must contain prescriptive criteria which are measurable and will guide selection of appropriate management actions in response to fires. The criteria can relate to suppression actions or describe when fire can be managed to gain resource benefits. This allows the use of a full range of appropriate management responses to fire, which may include: full suppression of a wildland fire; suppression on part of a wildland fire while allowing another portion of the fire to continue playing a natural ecological role and achieve resource benefits; or the use of prescribed fire.

Project plans are strategic plans to accomplish specific actions and goals established in a land use plan. Project plans may involve decisions regarding trade-offs between using mechanical, chemical and fire treatments. When projects include fires treatments, burn plans are also required. Burn plans are operational plans for managing specific fires. Burn plans prepared by

FLM's should include smoke management components to minimize fire emissions and mitigate air quality impacts.

b. Evaluating environmental impacts

Federal agencies evaluate the environmental impacts of the tools used for resource management on publicly owned lands using NEPA. They generally consider the impacts on, among other things, plant and animal species in the area, aquatic life, cultural resources, soil conditions, riparian areas, wetlands, water quality, air quality and visibility. Such analyses should be undertaken at both the individual project planning level and at the regional planning level if warranted by the extent of similar activities over a large area.

The impacts of resource management activities, particularly fire, on air quality can vary significantly by region. The impacts can be strongly affected by meteorology; existing air quality; the size, timing and duration of the activity; and other activities occurring in the same airshed at the same time. State/tribal air quality managers can provide technical assistance with evaluating potential air quality impacts, thus aiding FLM's in their selection of tools and evaluation of the environmental impacts.

Air quality and visibility impact evaluations of fire activities on Federal lands should:

- include recent historic (e.g. 10 years) and projected (life of the plan) annual or seasonal emissions from wildland and prescribed fires. Emission projections should be based on estimates provided by wildland owners/managers of acres burned, pre-burn fuel loading by vegetation type and consumption,
- be related to analyses of cumulative impacts of fires on regional and subregional air quality, when possible.
- identify applicable regulations, plans or policies (e.g. burn plans, authorization to burn, conformity, etc.),
- identify sensitive receptors,
- include description of planned measures to reduce smoke impacts,
- identify the potential for smoke intrusions into sensitive areas, and model air quality and visibility impacts, when possible,
- describe ambient air monitoring plans, when appropriate.

3. Role of State and Other Public Land Managers

State and local land management agencies manage publicly owned lands similar to Federal lands. These agencies differ from agency to agency, but can include forestry, conservation, park service, or fish and game agencies, as well as State or local fire protection agencies. Many agencies prepare long-range land use plans as well as project specific plans. The FMP's, similar to those prepared by Federal agencies, may also be prepared. Public land management agencies generally assess the environmental impacts of proposed projects, such as fires managed for resource benefits, although the impacts evaluated vary from agency to agency.

Some State/local wildland managers also have responsibilities for private lands. Such responsibilities may include using fires and other fuels reduction programs aimed at reducing the potential for wildfires in the wildland/urban interface.

Land use planning for State and locally owned wildlands, although somewhat different from the Federal process, also requires preparation of written documents that are subject to public review. State/local wildland managers should notify air quality managers of long-range plans to use fire for resource management. They should consider alternative management tools and evaluate the potential air quality impacts of fires. State/local wildland managers should also participate in the development of State SMP's.

4. Role of Private Land Managers

Private wildland owners/managers may or may not prepare written land use or project plans depending on the organization and the size of the property. States/tribes may or may not require written plans, but activities on privately owned lands must meet all applicable State and Federal environmental requirements. State requirements include any specific SIP requirements applicable to private land owners which are designed to ensure that the State complies with CAA requirements. Private land owners/managers should provide information to the State on long-range plans to use fire for resource management and should participate in the development of State SMP's.

5. Role of Indian Land Managers

Land use plans for Indian wildlands are not subject to review by the general public and are not subject to State regulations. Activities on Indian lands must meet the requirements of the CAA and the TIP, however, if one has been adopted. It is important that Indian wildland managers consider alternative vegetation management tools and consider the air quality impacts of the management practices chosen both on and off of Indian lands. They are encouraged to collaborate with other near-by wildland owners/managers and air quality managers on regional SMP's to assure that fires managed for resource benefits will not cause adverse air quality impacts at sensitive receptors in the region.

6. Role of Air Quality Managers

State air quality managers which have publicly owned wildlands within their jurisdiction, have a responsibility to participate in the public planning process conducted for those lands to be assured that air quality concerns are adequately addressed and they can meet the goals of their SIP's. They can participate in selecting the scope of land uses, identify air quality issues, and participate in evaluating and selecting alternative resource management tools. They can also participate in identifying basic air quality criteria for fire prescriptions. To accomplish this, air quality agencies should heed solicitations of public participation from land managers and contact public land management agencies within their jurisdiction

State/tribal air quality managers should also encourage private and Indian wildland owners/managers to consider alternative treatments and help them evaluate the potential air quality impacts of alternatives to meet particular management objectives.

B. Air Quality Management

State/tribal air quality managers are responsible for adopting plans and rules sufficient to attain and maintain national and State air quality standards, prevent significant deterioration of air quality, remedy existing visibility impairment and prevent future impairment in mandatory Class I Federal areas caused by manmade sources of pollution. This is accomplished mainly by developing SIP's and TIP's. The SIP's/TIP's include all programs and rules required by the CAA to meet and assure maintenance of Federal standards. The SIP's/TIP's are frequently amended as State/tribal rules are revised and new rules are adopted to meet changing CAA requirements. The

EPA has the authority to adopt and implement Federal Implementation Plans (FIP's) to address air quality protection in areas where States or tribes do not adopt plans.

1. Role of State/Local Air Quality Managers

The SIP's are developed in an extensive public process involving workshops and public hearings in which all stakeholders are invited to participate in developing the technical components of the plans including: (1) emission inventories; (2) modeling analyses; (3) attainment demonstrations; (4) transportation and general conformity emission budgets; (5) analyses of air quality data; and (6) control strategy development. State/local air quality managers should solicit information on the planned use of fire for resource management from all wildland owners/managers, just as they obtain information on other emission sources within their jurisdiction, when fires are expected to significantly impact air quality. Air quality managers should also work with adjacent States to mitigate potential impacts from interstate transport of smoke.

2. Role of Tribal Air Quality Managers

Eligible tribes may develop TIP's to administer CAA requirements on Indian lands. The CAA recognizes tribal governments as the most appropriate parties to regulate the environment on Indian lands and grants EPA the authority to approve tribal programs. The EPA has developed strategies for Federally implementing CAA requirements if tribes do not adopt TIP's.

Tribal air quality managers should solicit information on the planned use of fire for resource management within their jurisdiction and the potential for air quality impacts on or from adjacent jurisdictions. They are encouraged to collaborate with other near-by air quality managers to develop regional SMP's which assure that fire activities will not cause adverse air quality impacts at sensitive receptors in the region.

3. Role of Public Land Managers

Public land managers have the responsibility to participate with the other stakeholders and air quality managers in developing SIP's. Public land managers, as experts in what is needed to meet land use and other environmental objectives, need to provide information on the areas that are to be treated with fire, air pollutant emissions estimates, and assistance in developing programs to track emissions, monitor air quality and visibility, and mitigate air quality impacts.

The FLM's of mandatory Class I Federal areas must participate in the development of SIP's for regional haze and visibility impairment. Congress gave FLM's a key consulting role in the administration of visibility protection and "affirmative responsibility to protect air quality related values (including visibility) in mandatory Class I Federal areas." [See section 165 of the CAA.]

VI. SMOKE MANAGEMENT PROGRAMS (SMP's)

The SMP's establish a basic framework of procedures and requirements for managing smoke from fires managed for resource benefits and are typically developed by States/tribes with cooperation and participation by wildland owners/managers. The purposes of SMP's are to mitigate the nuisance and public safety hazards (e.g., on roadways and at airports) posed by smoke intrusions into populated areas; to prevent deterioration of air quality and NAAQS violations; and to address visibility impacts in mandatory Class I Federal areas. Some strong indications that an area needs a SMP are: (1) citizens increasingly complain of smoke intrusions; (2) the trend of monitored air quality values is increasing (approaching the daily or annual NAAQS for $PM_{2.5}$ or PM_{10}) because of significant contributions from fires managed for resource benefits; (3) fires cause or significantly contribute to monitored air quality that is already greater than 85 percent of the daily or annual NAAQS for $PM_{2.5}$ or PM_{10}; or (4) fires in the area significantly contribute to visibility impairment in mandatory Class I Federal areas.

If a State/tribe determines that a SMP is needed, they can adopt any type of program they believe will prevent NAAQS violations and address visibility impairment. For example, general fire regulations may establish basic parameters, such as wind speed, direction, location and distance to sensitive receptors, etc., within which fires can be ignited or naturally ignited fire can be allowed to continue to burn. States/tribes may allow wildland owners/managers to voluntarily notify them of fire plans or may require prior authorization. They may also exempt de minimis fires (fires that will cover fewer than X acres or consume less than Y tons of fuel, as established by the State/tribe) from meeting the regulations. Such regulations leave much discretion to wildland owners/managers as to when to ignite fires, and what management strategy to follow with naturally ignited fires. States/tribes may exercise enforcement authorities when wildland owners/managers are found to have ignited the fire outside of the parameters of the rule, or not to

have appropriately responded to air quality impacts caused by naturally ignited fires.

General fire regulations may be adequate for areas where fires managed for resource benefits rarely cause or contribute to air quality problems. However, when plans to use fire on a large scale could cause significant air quality impacts, or several wildland owners/managers within an airshed are expected to use fires concurrently, a more structured SMP requiring cooperation and coordination of fire activities may be required to minimize emissions and mitigate the air quality impacts.

State/tribal air quality managers, public wildland managers, private and Indian wildland owners/managers, and the general public should collaborate in the development and implementation of State/tribal SMP's. The State/tribal air quality manager must certify in a letter to the Administrator of EPA that at least a basic program has been adopted and implemented in order to receive special consideration under this policy of air quality data resulting from fire impacts, as explained in section VII. The SMP does not have to be incorporated into the SIP/TIP or be Federally enforceable, however. The following describes the basic components (A - F) of a certifiable SMP. There is considerable latitude within the components for individual State/tribal preferences.

A. <u>Authorization to Burn</u>

The SMP should include a process for authorizing or granting approval to manage fires for resource benefits within a region, State, or on Indian lands and identify a central authority responsible for implementing the program. The process may be as simple as receiving applications for permission to burn and granting approval via telephone or facsimile. The SMP central authority must review fire applications, consult with the applicants, if necessary, and promptly make burn/no burn decisions. When authorizing a fire, the authority should consider all open burning activities (land clearing and construction wastes, agricultural wastes, etc.) allowed within an airshed. The central authority should strive to treat public and private wildland owners/managers equitably when authorizing fires. Neighboring States/tribes are encouraged to create partnerships to coordinate fire projects when inter-jurisdictional impacts are expected, so as to meet air quality and fire management objectives. Fire emissions should be minimized and the air quality impacts should be mitigated regardless of political boundaries.

States/tribes may or may not require written burn plans for de minimis fires, especially if the central authority records pertinent fire information. However, written burn plans are strongly recommended for greater than de minimis fires. Burn plans should be prepared by the wildland owners/managers. The central authority should assist private land owners that cannot prepare their own plans. When written burn plans are required, especially for fires on publicly owned lands, they should include such information as the:

- location and description of the area to be burned,
- personnel responsible for managing the fire,
- type of vegetation to be burned,
- area (acres) to be burned,
- amount of fuel to be consumed (tons/acre),
- fire prescription including smoke management components (discussed below),
- criteria the fire manager will use for making burn/no burn decisions,
- safety and contingency plans addressing smoke intrusions.

The central authority's criteria for authorizing fires should be based on existing air quality and the ability of the airshed to disperse emissions (e.g., meteorological conditions) from all burning activities on the day of the burn. For fires lasting longer than one day, predicted meteorological conditions for several days should be considered to avoid aggravating existing problems. Persons receiving authorization to ignite fires must comply with all applicable local, State, tribal and Federal requirements. Persons responsible for managing greater than de minimis fires should be adequately trained in fire and smoke management. Fire managers should be required to follow the authorized burn plan or explain why it was necessary to deviate from the plan.

B. <u>Minimizing Air Pollutant Emissions</u>

The SMP should encourage wildland owners/managers to consider the alternative treatments discussed in section V.A.1., above. Public land managers typically consider and evaluate alternative treatments that may achieve management objectives, their costs and the environmental impacts of each method. States/tribes should assist private land owners to also identify economically feasible treatments that will meet their objectives with minimum air pollutant

emissions. When the use of fire is selected as the best means to accomplish management goals, there are several ways to reduce emissions from a single fire. The approaches fall into four categories and their applicability varies by fuel type, (1) minimize the area burned, (2) reduce the fuel loading in the area to be burned, (3) reduce the amount of fuel consumed by the fire, (4) minimize emissions per ton of fuel consumed. These emission reduction techniques rely almost exclusively on reducing the amount of fuel consumed by a particular fire. The excluded fuels could be consumed by a subsequent fire, however, unless they are removed from the area or biologically decompose. Also, generally these techniques cannot be used to reduce emissions from naturally ignited fires.

Emission reduction techniques are discussed further in the white paper "What Wildland Fire Conditions Minimize Emissions and Hazardous Air Pollutants and Can Land Management Goals Still be Met?" See Section I to obtain a copy.

C. Smoke Management Components of Burn Plans

When burn plans are required they should include the following smoke management components.

1. Actions to Minimize Fire Emissions

The burn plan should document the steps taken prior to the burn and actions that will be taken during and after the burn to reduce air pollutant emissions. This includes measures that will be taken to reduce residual smoke, such as rapid and complete mop-ups, mop-ups of certain fuels, etc.

2. Evaluate Smoke Dispersion

The central authority should evaluate dispersion conditions prior to authorizing fires. Burn plans should evaluate potential smoke impacts at sensitive receptors and time fires to minimize exposure of sensitive populations and avoid visibility impacts in mandatory Class I Federal areas. The plan should identify the distance and direction from the burn site to local sensitive receptor areas and to regional/interstate areas where appropriate. Fire prescriptions submitted prior to the day of the fire must specify minimum requirements for the atmospheric capacity for smoke dispersal such as minimum surface and upper level wind speeds, desired wind direction, minimum mixing height, and dispersion index. It may be necessary to purchase

meteorological services from private companies if they are not available from the National Weather Service.

3. Public Notification and Exposure Reduction Procedures

The plan should identify actions that will be taken to notify populations and authorities (e.g., local air quality managers) at sensitive receptors, including those in adjacent jurisdictions, prior to the fire. The plan should also identify contingency actions that will be taken during a fire to reduce the exposure of people at sensitive receptors if smoke intrusions occur. The central authority should perform these functions, if needed, for some private land owners. Appropriate short-term (less than 24-hour) contingency actions may, among other things, include:

- Notifying the affected public (especially sensitive populations) of elevated pollutant concentrations,
- Suggesting actions to be taken by sensitive persons to minimize their exposure (e.g., remain indoors, avoid vigorous activity, avoid exposure to tobacco smoke and other respiratory irritants),
- Providing clean-air facilities for sensitive persons,
- Halting ignitions of any new open burning that could impact the same area,
- Analyzing the fire situation and identifying alternative management responses upon becoming aware that a fire is out of air quality prescription with regard to the air quality criteria, (Federal land management agencies perform a Wildland Fire Situation Analysis)[3],
- Consulting State/tribal air quality managers regarding appropriate short-term fire management response to abate verified impacts,
- Implementing management responses that will mitigate the adverse impacts to public health,

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[3] A Wildfire Situation Analysis (WFSA) is a decision-making process that evaluates alternative fire management strategies considering fire fighter and public safety, risk to property and resources, fire fighting resources available, land management objectives, and environmental, social, economic and political constraints. The environmental and social constraints considered include, among other things, how air quality and/or visibility will be affected at sensitive receptors by each alternative fire management strategy. The positive, neutral or negative effects of each alternative on the criteria above are weighed to select the appropriate management response to the fire. Therefore, while mitigating air quality and visibility impacts must be considered by the FLM when managing a fire that is not within a prescription, they are just two of several important criteria evaluated.

- Reporting the steps taken to mitigate adverse impacts to the public and appropriate State/tribal agencies after they have been completed.

4. Air Quality Monitoring

The plan should identify how the effects of the fire on air quality at sensitive receptors, and visibility in mandatory Class I Federal areas will be monitored. The extent of the monitoring plan should match the size of the fire. For small fires, visual monitoring of the direction of the smoke plume and monitoring nuisance complaints by the public may be sufficient. Other monitoring techniques include posting personnel on vulnerable roadways to look for visibility impairment and initiate safety measures for motorists; posting personnel at other sensitive receptors to look for smoke intrusions; using aircraft to track the progress of smoke plumes; and continued tracking of meteorological conditions during the fire. For large fires expected to last more than one day, locating real-time PM monitors at sensitive receptors may be warranted to facilitate timely response to smoke impacts. If needed, the central authority may perform these monitoring functions for some private land owners.

For additional information on monitoring wildland fire impacts see the white paper "Air Monitoring for Wildland Fire Operations." See Section I to obtain a copy.

D. <u>Public Education and Awareness</u>

The SMP should establish criteria for issuing health advisories when necessary, and procedures for notifying potentially affected populations, including those in adjacent jurisdictions, of planned fires. A program should be implemented to explain the use and importance of fire for ecosystem management, the implications to public health and safety, and the goals of the SMP. Wildland and air quality managers should work with the press to announce pre-fire health advisories, and post-fire results including such things as the management objectives met; smoke intrusions observed, and/or successful minimization of air quality impacts.

E. <u>Surveillance and Enforcement</u>

The SMP should include procedures to ensure that wildland owners/managers will comply with the requirements of the SMP. Fire managers must follow the burn plan, including the fire prescription and smoke management components, or explain any deviations from the plan. Memorandums of understanding may be used to specify the responsibilities of each State/tribal

agency in implementing the SMP.

F. Program Evaluation

The SMP should provide for periodic review by all stakeholders of its effectiveness and revision of the program as necessary. The effectiveness review should be based on observations such as reports of smoke intrusions, nuisance complaints, and monitored air quality impacts. Post-burn reports should be required for fires that exceed their air quality prescription and/or fires that cause smoke impacts at sensitive receptors. Post-burn reports for escaped fires should describe the incident, describe the contingency plan implemented, and provide recommendations to prevent future smoke related problems.

State/tribal SMP's should include procedures for re-evaluating the effectiveness of rules and regulations every 3 to 5 years. Such procedures should involve all the original participants (e.g., wildland owners/managers, air quality managers, the public, etc.) and should review the:

- Acres of fires managed for resource benefits planned for the next 5 years,
- Need to expand the scope of the program to include authorization of other open burning,
- Need for changes in the SMP.

G. Optional Air Quality Protection

The following components are not required in a basic SMP, but States/tribes may adopt more stringent SMP's or include additional smoke management requirements. For example, "special protection zones" may be established to provide better protection against smoke impacts. Special protection zones could be buffers (e.g., 10 - 25 miles) around wildland/urban interface areas, nonattainment areas, or mandatory Class I Federal areas. Additional requirements for burns within a special protection zone may include no burning if high pollution levels already exist in the area. Also, special protections may only be required for burns that will last overnight, for multi-day burns or burns during specific seasons.

States/tribes may also establish "performance standards" that would trigger implementation of additional smoke management requirements if exceeded in an area. The performance standards could set limits on the frequency and intensity (e.g., hours/day, PM concentration, visibility impairment) of smoke intrusions. Implementation of performance

standards may require real-time monitoring of air quality. Additional requirements for fires after the performance standards are exceeded may include better dispersion parameters (e.g., increased wind speed, mixing height, dispersion index, etc.).

VII. ACCOUNTABILITY

A. Role of State/Tribal Air Quality Managers

High PM concentrations attributable to fires managed for resource benefits are valid air quality data that can be used to determine the attainment status of the area represented by the data for both the daily and annual NAAQS. State/tribal air quality managers are responsible for monitoring citizen complaints and air quality trends attributable to fires to determine when a SMP is needed to minimize emissions and mitigate air quality impacts. Air quality managers should initiate the collaborative process needed to develop and adopt regulations for a SMP. If the State/tribal air quality manager certifies in a letter to the Administrator of EPA that at least a basic program (described in section VI) has been adopted and implemented, special consideration will be given under this policy to air quality data resulting from fires managed for resource benefits.

1. Wildfires

High PM concentrations attributable to wildfires (unwanted wildland fires) can be treated as due to a natural event under EPA's Natural Events Policy. The Natural Events Policy provides that when areas violate the PM_{10} NAAQS due to a natural event, EPA will: (1) exercise its discretion, under section 107(d)(3) of the CAA, not to redesignate areas as nonattainment if the State develops and implements a plan to respond to the health impacts of natural events; and, (2) redesignate nonattainment areas as attainment by applying appendix K, on a case-by-case basis, to discount [ambient air quality] data in circumstances where an area would attain but for exceedances that result from uncontrollable natural events. The elements of a State/tribal action plan to respond to the health impacts of natural events are described in the Natural Events policy statement. The EPA plans to revise the Natural Events Policy to also cover $PM_{2.5}$ NAAQS violations.

2. Fires Managed for Resource Benefits

High PM concentrations attributable to fires managed for resource benefits will be given special consideration under this policy, as described in section VII.B., if the State/tribe has

certified to EPA that it is implementing a basic SMP. States/tribes should flag monitored values influenced by fires when submitting the data to EPA's Atmospheric Information Retrieval System. They must also document the basis for flagging the data. Supporting information could include the location of fires relative to the monitor, meteorological data such as wind speed and direction, filter analyses indicating heavy carbon deposits, the sample date (collected during the fire season), and the absence of other carbon sources during that period, among other things. The documentation should address the possible influence of other carbon sources such as wood-fired boilers, residential wood combustion and wildfires. The type and amount of documentation should be sufficient to demonstrate that fires managed for resource benefits caused flagged values to be above the level of the annual NAAQS. The documentation should be made available to the public for review. [For example, newspaper announcements, periodic air quality reports, distribution at public meetings.]

When smoke intrusions cause high PM concentrations, air quality managers have two goals: (1) to reduce immediate impacts on public health, and (2) to take appropriate steps to mitigate future impacts. To meet these goals, air quality managers must contact the wildland owner/manager responsible for the fire(s) to determine the cause of the impacts. The air quality manager should verify that contingency actions to reduce exposure are being implemented, and determine whether, (i) the fire was authorized, (ii) a burn plan (including the smoke management components) was followed, (iii) the prescription failed and why.

If requirements of the SMP were not met, the State/tribe can exercise various enforcement authorities to address the problem. If the fire manager complied with the SMP, the adequacy of the requirements should be reviewed. If air quality data are frequently flagged as resulting from failure of the smoke management components of the burn plan, EPA will call on the State/tribe to work with wildland owners/managers to improve future burn plans and the SMP. When a fire managed for resource benefits breaks out of its fire prescription, and cannot be returned to the prescription, the fire manager will treat it as a wildfire for the purposes of suppression. However, any resulting high PM concentrations must continue to be addressed under this policy, and the data can not be treated as due to a wildfire natural event.

B. Role of the Environmental Protection Agency

1. Impacts with a SMP

If fires managed for resource benefits cause or significantly contribute to violations (see definition) of the daily or annual $PM_{2.5}$ or PM_{10} NAAQS, the State/tribe must submit the following documentation to EPA to avoid a SIP/TIP call or redesignation of the area to nonattainment:

- Evidence supporting the finding that flagged air quality values were due to fires managed for resource benefits,
- Evidence that the fires were subject to a certified State/tribal SMP.

The State/tribe may consider that such fires caused or significantly contributed to violations of the daily NAAQS if 25 percent of all the PM concentrations that are above the level of the daily NAAQS, have been flagged as being due to fire impacts.

The State/tribe may consider that such fires caused or significantly contributed to violations of the annual NAAQS if the sum of the measured concentrations for all days flagged as due to fires, divided by the total number of sample days (fire days plus non-fire days) is greater than or equal to 25 percent of the annual NAAQS (i.e., 4 $\mu g/m^3$ for $PM_{2.5}$ or 12 $\mu g/m^3$ for PM_{10}).

If the evidence is convincing, EPA will exercise its discretion under section 107(d)(3) not to redesignate the area as nonattainment. Rather, following the first NAAQS violation based on 3 calendar years of PM air quality data, EPA will call on the State/tribe to review the effectiveness of the SMP in collaboration with wildland owners/managers and make appropriate improvements to mitigate future air quality impacts. The same procedure will be followed if a second NAAQS violation occurs the following year. If fires cause or significantly contribute to a third consecutive NAAQS violation, EPA will call for the SMP to be made part of the SIP/TIP and be Federally enforceable.[4] If the area was designated nonattainment previously, EPA will also call on the State/tribe to review the effectiveness of the SMP and make appropriate improvements.

2. Impacts Without a SMP

If a certified SMP has not been implemented, EPA will not give special consideration to the high PM concentrations attributed to fires managed for resource benefits that cause or

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[4]For example, the first violation of the PM_{10} NAAQS may be determined using air quality data for calendar years 1997-1999. Subsequently, 1998-2000 data for the same area could show a second violation, and data for 1999-2001 could identify a third violation for the area.

significantly contribute to: (1) violations of a $PM_{2.5}$ or PM_{10} NAAQS, (2) visibility impairment in mandatory Class I Federal areas, or (3) failure to achieve reasonable progress toward the national visibility goal. Rather, EPA will call for adoption of the basic SMP, described in section VI, as part of the SIP/TIP for PM and visibility. The EPA will also notify the governor of the State or the tribal government that the area should be redesignated as nonattainment. The SMP adopted in response to the SIP/TIP call must require mandatory participation for greater than de minimis fires, must be adopted into the SIP/TIP, and must be Federally enforceable. The SIP/TIP will also have to meet all other CAA requirements applicable to nonattainment areas.

3. Interstate Transport of Smoke

Several key provisions of the CAA address interstate pollutant transport. Section 110(a)(2)(D) provides that a SIP must contain provisions preventing subject sources from contributing significantly to nonattainment problems or interfering with maintenance in any other State. That section also prohibits interference with any SIP required measures under part C to prevent significant deterioration or to protect visibility. Section 169A authorizes EPA to promulgate regulations requiring states that "may reasonably be anticipated to cause or contribute to" visibility impairment in mandatory Class I Federal areas to include in their SIP's measures necessary to eliminate or reduce such impairment. Section 126 provides that, in response to petitions from government entities regarding significant pollutant transport, EPA may prescribe certain corrective measures. Also, sections 169B, 176A and 184 contain provisions for cooperatively addressing interstate pollution problems by establishing interstate transport regions and commissions to address region wide pollution and visibility concerns. The EPA promulgated a final rule, pursuant to the requirements of section 301(d) of the CAA that authorizes eligible Indian tribes to also implement these provisions.[5] If fires managed for resource benefits in one State (or on Indian lands) cause or significantly contribute to NAAQS violations in another State (or on Indian lands), EPA is authorized to take action under section 110(k)(5) of the CAA to address the problem. If, among other things, EPA finds that a SIP/TIP is substantially inadequate to attain or maintain the NAAQS, it may require the SIP/TIP to be revised to correct the

[5]See Volume 63 Federal Register 7254, February 12, 1998.

inadequacy (e.g., transported smoke).

C. Role of Wildland Owners/Managers

Wildland owners/managers are responsible for following State/tribal regulations applicable to fires, obtaining authorization to burn, and following the approved burn plan, when one is required. Owners/managers are responsible for taking appropriate actions to control the fire and reduce exposure to smoke when adverse air quality impacts result from a failure of the air quality prescription or an escaped fire.

There is a special need for fires managed by Federal agencies to have burn plans that include smoke management components. Fires managed by Federal agencies are most likely to impact air quality in recreation areas (national parks, forest, etc.) and impair visibility in mandatory Class I Federal areas. The EPA encourages Federal agencies to include smoke management components in all burn plans, regardless of the existence of a State/tribal SMP.

VIII. DATA ON WILDLAND and PRESCRIBED FIRES

Most of a State/tribal program to protect air quality is contained in a SIP or TIP. Since the use of fire for resource management is expected to increase substantially, especially on Federal lands, State/tribal air quality managers will need information to develop potential annual or seasonal air pollutant emission estimates for SIP/TIP planning. As for any source, emissions from fires can be estimated by multiplying the estimated level of activity by an emission factor. The level of activity for fire is the mass of biomass (fuel) consumed, usually expressed in tons. Emission factors expressed in pounds per ton of fuel consumed are available in EPA's publication AP-42 (which is scheduled to be updated). Emission factors are derived from an estimate of overall combustion efficiency (i.e. stoichiometric ratio). The mass of fuel consumed is the product of fire size (acres), pre-burn fuel loading (tons per acre), and fuel consumption (percent of pre-burn loading). An emission inventory can be compiled by the affected air agency for an individual fire, a statistical class of fires, a burn program, or a population of fires in a given area over a period of time based on this information.

Federal land management agencies currently collect data on wildland and prescribed fires, however, no standard reporting format is followed. These raw data are usually limited to the time and approximate location of the fire, fire perimeter area, weather (occasionally) and a

qualitative description of fuels at the point of ignition. The data are not collected for the purpose of calculating air pollutant emissions and are probably inadequate for that purpose.

A National Interagency Fire Statistics Information Project has been initiated to develop an easily accessible system for storing a set of commonly agreed upon fire data. Post-burn data, such as that described above, on future wildland and prescribed fires would be stored in this database. The database will be accessible by air quality managers to estimate past, current, and future emission trends from this source category.

The EPA encourages the Federal land management agencies to develop the fire statistics database and FLM's to report fire data to the system. These fire data will be needed by air quality managers in regions where most wildland and prescribed fires occur on Federal lands. Air quality managers should request similar fire data for wildland and prescribed fires on State, private and Indian wildlands as well as information on other types of open burning to complete their emission inventories.

Statewide emissions from fire use in all 50 states during 1989 have been estimated based on a survey of [Federal, State and private] land owners/managers. [Ref. Peterson/Ward] Also, a spatially resolved inventory of prescribed burning by county for 1990 and by 50km grid for 1995, 2015 and 2040 was prepared for 10 western States as part of the Grand Canyon Visibility Transport Commission's activities. [Ref. Peterson/Lahm] The emission estimates are based on fuel models derived from 14 types of vegetative cover spatially mapped throughout the area and estimates of fuel loadings as either low, medium or high. The procedures followed by Peterson and Lahm to estimate emissions for the western states provide a good model for developing emissions estimates for other areas, also.

Further information on developing emissions estimates and the data required can be found in the white paper "Emission Inventories for SIP Development." See Section I to obtain a copy.

IX. MEETING OTHER CLEAN AIR ACT REQUIREMENTS

A. Demonstrate Conformity of Federal Activities

Activities on Federal lands must meet the requirements of the CAA, including the provisions of section 176(c), that such activities "conform" to the purpose of the applicable SIP. The EPA's Conformity rules, implementing the provisions of section 176(c), only apply to

Federal actions taken within a nonattainment or maintenance area. The Transportation Conformity rules govern transit-related activities, and all other type of activities are governed by the General Conformity rules. The rules require a Federal agency to demonstrate, prior to initiating a project, that its action conforms to all applicable requirements in a SIP and will not cause or contribute to NAAQS violations. The General Conformity rules provide Federal agencies with several options for demonstrating conformity. The following options are most typically followed : (1) a modeling demonstration to show that emissions from the project will not increase the frequency or severity of a NAAQS violation, (2) obtaining emission reductions that offset the new project emissions, or (3) showing that the project's emissions are already included in, or accommodated by, the emissions inventory of the SIP for the relevant nonattainment or maintenance area. Federal activities occurring on tribal lands will be addressed by EPA consistent with its Tribal Air Rule and the requirements of the CAA.

The above procedures can be followed to demonstrate conformity of fire projects for a Federal land management agency's administrative units based on the FMP's developed for such units. The demonstration can be made on an annual basis for all burns within the airshed of a nonattainment or maintenance area. Alternatively, the demonstration can be made for each individual fire project conducted at the administrative unit.

In addition to the previously cited methods for demonstrating conformity of Federal fire projects, EPA will pursue, in consultation with the other Federal agencies, adding an alternative method to the General Conformity rules through rulemaking. At a minimum, EPA believes that the alternate method should require a Federal agency to document that its fire projects are managed within a certified SMP. The SMP also must require regional coordination (cooperation of all jurisdictions in an airshed) of burn plan authorization and real-time air quality monitoring at sensitive receptors, when warranted, in addition to the basic program components discussed in section VI.

B. Visibility/Regional Haze Requirements

The EPA's visibility regulations (45 FR 80084, December 2, 1980) protect mandatory Class I Federal areas from manmade impairment that is "reasonably attributable" to a single emission source or small group of sources. FLM's for mandatory Class I Federal areas have a key

consultative role and responsibility to participate in the development of SIP's for visibility impairment that is reasonably attributable to specific sources. In Part C of the CAA which includes the visibility protection mandate, Congress assigned FLM's the "affirmative responsibility to protect air quality related values (including visibility)" in mandatory Class I Federal areas. Under EPA's regulations, States must take appropriate actions to address all sources of visibility impairment, including fires, in response to a FLM's certification of reasonably attributable impairment in mandatory Class I Federal areas.

A new regulatory program to protect mandatory Class I Federal areas from "regional haze" impairment was proposed by EPA on July 31, 1997 (62 FR 41137). After the regional haze rules become final, States will need to address the impacts of fires and other contributing sources on meeting reasonable progress in their control strategy analyses, as well as during periodic progress assessments. The EPA will revisit this section of the Air Quality Policy on Wildland and Prescribed Fires after the final rules for implementing the regional haze program have been promulgated. The EPA will also develop guidance on assessing natural background visibility to aid in implementing the regional haze rules, and will consider the following paper at that time. The white paper "Estimating Natural Emissions From Wildland and Prescribed Fire" presents preliminary options for defining natural wildland and prescribed fire emissions that may or may not be consistent with the final regional haze rules. See Section I to obtain a copy.

C. Prevention of Significant Deterioration

Title I, part C of the CAA requires SIP's to include provisions to prevent the significant deterioration of air quality in areas designated as attainment or unclassifiable for any NAAQS. "Significant deterioration" for any pollutant is defined as an unacceptable incremental increase in ambient concentrations above the baseline concentration for that pollutant in an area. The PSD "increments" have been established for SO_2, NO_2, and PM_{10}. The EPA adopted NAAQS for $PM_{2.5}$, which became effective on September 16, 1997. However, no increments have yet been promulgated for $PM_{2.5}$.

The SIP's are required to contain emission limits and such other measures as may be necessary to prevent significant deterioration of air quality. See section 161 of the Act. In addition, SIP's are required to include a preconstruction review permit program for new and

the fuel moisture condition and other physical parameters. Other criteria which may be considered include safety, economic, public health, environmental, geographic, administrative, social or legal considerations, and ecological and land use objectives.

Prevention of Significant Deterioration (PSD): A requirement in the CAA, which establishes the maximum allowable increases in ambient air concentrations of selected air pollutants above baseline concentrations in areas designated as Class I, Class II, or Class III.

Project Plan: A strategic plan for accomplishing specific actions and goals (objectives) established in a land use plan. A project may include several activities such as cutting and hauling trees and shrubs, planting trees, building trails, and fire treatment.

Regional Haze: Generally, concentrations of fine particles in the atmosphere extending up to hundreds of miles across a region and promoting noticeably hazy conditions; wide-spread visibility impairment, especially in mandatory Class I Federal areas where visibility is an important value.

Sensitive Receptors: Population centers such as towns and villages, camp grounds and trails, hospitals, nursing homes, schools, roads, airports, mandatory Class I Federal areas, etc. where smoke and air pollutants can adversely affect public health, safety and welfare.

Smoke Management Program (SMP): Establishes a basic framework of procedures and requirements for managing smoke from fires that are managed for resource benefits. The purposes of SMP's are to mitigate the nuisance and public safety hazards (e.g., on roadways and at airports) posed by smoke intrusions into populated areas; to prevent deterioration of air quality and NAAQS violations; and to address visibility impacts in mandatory Class I Federal areas in accordance with the regional haze rules.

State Implementation Plan (SIP): A CAA required document in which States adopt emission reduction measures necessary to attain and maintain NAAQS, and meet other requirements of the Act.

Suppression: A management action intended to protect identified values from a fire, extinguish a fire, or alter a fire's direction of spread.

Tribal Implementation Plan (TIP): A document authorized by the CAA in which eligible tribes adopt emission reduction measures necessary to attain and maintain NAAQS, and

meet other requirements of the CAA for lands within tribal jurisdictions.

Violation of the PM NAAQS: As revised in 1997, the daily PM_{10} standard is violated when the 99th percentile of the distribution of 24-hour concentrations for a period of 1 year (averaged over 3 calendar years) exceeds 150 $\mu g/m^3$ at any monitor within an area. The annual PM_{10} standard is violated when the arithmetic average of 24-hour concentrations for a period of 1 year (averaged over 3 calendar years) exceeds 50 $\mu g/m^3$ at any monitor within an area.

The new NAAQS levels for $PM_{2.5}$ are set at a daily concentration less than or equal to 65 $\mu g/m^3$, and an annual mean concentration of less than or equal to 15 $\mu g/m^3$. The daily standard is violated when the 98th percentile of the distribution of the 24-hour concentrations for a period of 1 year (averaged over 3 calendar years) exceeds 65 $\mu g/m^3$ at any monitor within an area. The annual standard is violated when the annual arithmetic mean of the 24-hour concentrations from a network of one or more population-oriented monitors (averaged over 3 calendar years) exceeds 15 $\mu g/m^3$. Compliance with the annual $PM_{2.5}$ NAAQS is based on population-oriented monitors because the health information, upon which the standard is based, relates area-wide health statistics to area-wide air quality as measured by one or more monitors.

Volatile Organic Compounds (VOC): Any organic compound which participates in atmospheric photochemical reactions, which are measured by a reference method, an equivalent method, or an alternative method. Some compounds are specifically listed as exempt due to their having negligible photochemical reactivity. [See 40 CFR 51.100.] Photochemical reactions of VOC's with oxides of nitrogen and sulfur can produce O_3 and PM.

Wildfire: An unwanted wildland fire.

Wildland: An area where development is generally limited to roads, railroads, power lines, and widely scattered structures. The land is not cultivated (i.e., the soil is disturbed less frequently than once in 10 years), is not fallow, and is not in the United States Department of Agriculture (USDA) Conservation Reserve Program. The land may be neglected altogether or managed for such purposes as wood or forage production, wildlife, recreation, wetlands or protective plant cover. **[The distinction between wildlands, to which the recommendations in this document apply, and agricultural lands is subject to further discussion.]**

Wildland Fire: Any non-structural fire, other than prescribed fire, that occurs in the

wildland. Note: Wildland fires include unwanted (wild) fires and naturally ignited fires that are managed within a prescription to achieve resource benefits.

Wildland Fire Situation Analysis (WFSA): A real time decision-making process carried out by federal land management agencies to select an appropriate management response to wildland fire. The WFSA considers fire fighter and public safety, risk to property and resources, fire fighting resources available, land management objectives and environmental, social economic and political constraints. The environmental and social constraints considered include, among other things, how air quality and/or visibility will be affected at sensitive receptors by each alternative fire management strategy.

Wildland/Urban Interface: The line, area or zone where structures and other human development meets or intermingles with the wildland.

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CLEAN DAYS

VISUAL RANGE

BASELINE DATA

in Kilometers for western US

ROCKY MOUNTAIN
FOREST AND RANGE
EXPERIMENT STATION

CIRA Colorado State University
Cooperative Institute for Research in the Atmosphere

To: 1/7/98
FLAG Visibility Subgroup

The purpose of these maps with respect to FLAG is that the numbers would be used as "background" SVRs for plume modeling. Jim Sisler and I are generating similar maps which show the amount of extinction due to hygroscopic species and non-hygroscopic species. That information would be used for regional haze modeling.

The original goal of this project was to determine the range of visibility conditions at each USFS Class I Wilderness where monitoring has been done. These maps are a synthesis of USFS quantitative camera monitoring, and IMPROVE and IMPROVE protocol aerosol and optical monitoring. The period of record used for the analysis was the entire site history, which varies from one year to roughly 8 years.

The first two maps (east & west) give the four letter site code for each site I used. The colors indicate what kind of sampling was used to generate the number. The second pair of maps is my best guess for 90th percentile SVR at each site, NOT each wilderness, that's a separate set of maps. The entire project consists of 16 maps showing east/west, Class I/Site, 10th 50th and 90th percentile SVRs. I'm just sending the two most relevant map pairs to keep the paper to a minimum.

The first table below shows the algorithms I used to generate the numbers, including the minimum number of samples required for me to include a site's data. The second table lists the "representative" part of the project, where FS Class I Wildernesses were assigned to one or two sites from the wilderness, a nearby IMPROVE site, or no site if no data was available.

Let me know if you have any comments or questions.

Sincerely,

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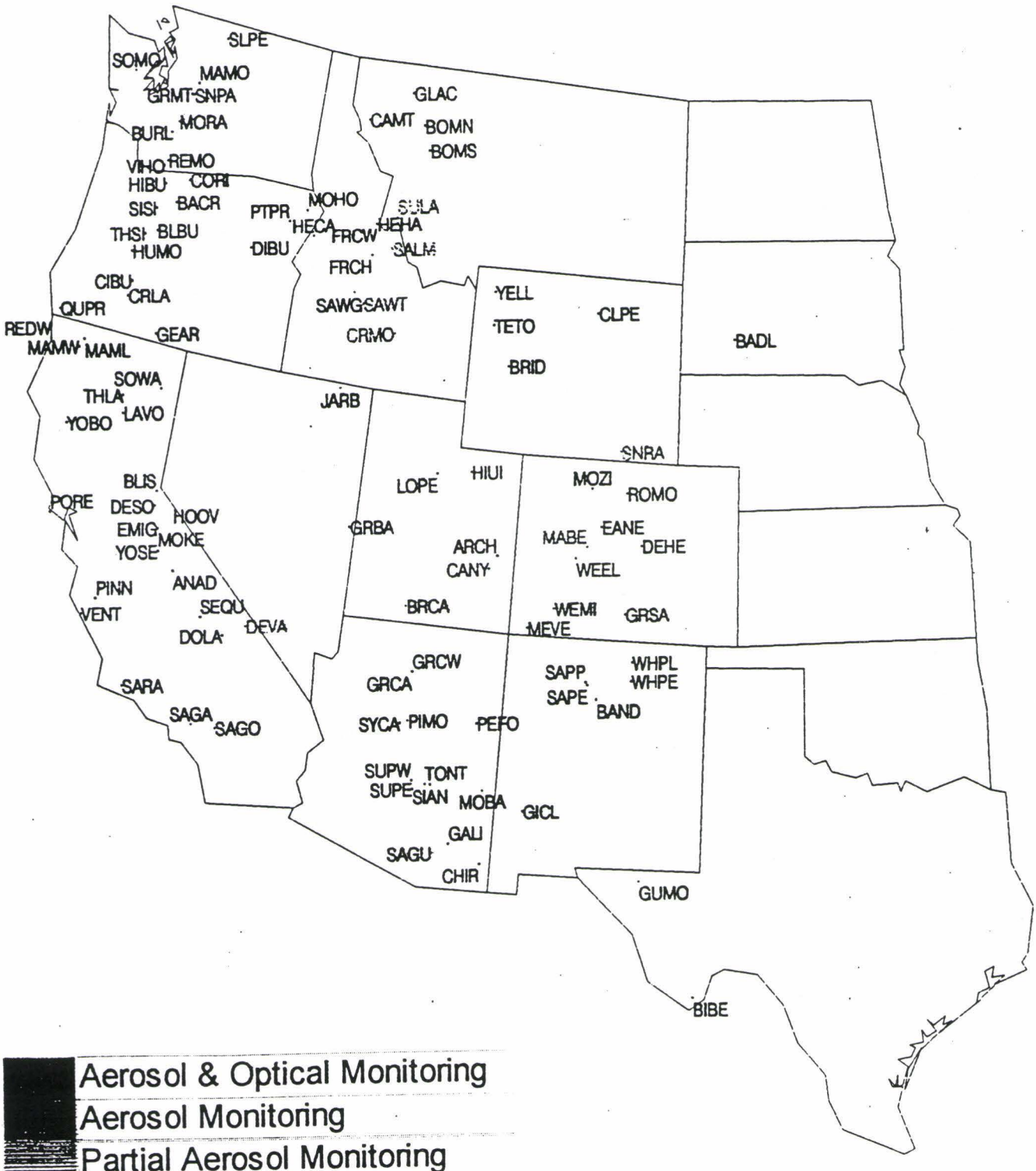
C1 Wilderness Name	Site1	Site2	C1 Wilderness Name	Site1	Site2
Pasayten	SLPE		North Absaroka	YELL	
Glacier Peak			Washakie	YELL	
Alpine Lakes	SNPA		Teton	YELL	
Goat Rocks	BURL		Fitzpatrick	BRID	
Mt. Adams	REMO		Bridger	BRID	
Mt Hood	HIBU		Rawah		
Hells Canyon	HECA	MOHO	Mt. Zirkel	MOZI	
Eagle Cap	PTPR		Flat Tops		
Mt Jefferson	SISI		Eagles Nest	EANE	
Strawberry Mtn	DIBU		Maroon Bells - Snowmass	WHRI	
Mt Washington	BLBU		West Elk	WEEL	
Three Sisters	THSI		La Garita		
Diamond Peak	CIBU		Weminuche	WEMI	
Gearhart Mtn	GEAR		Sycamore Canyon	SYCA	
Kalmiopsis	QUPR		Pine Moutain	PIMO	
Mountain Lakes			Mazatzal		
Marble Mountain	MAML	MAMW	Mt. Baldy	MOBA	
South Warner	SOWA		Sierra Ancha	SIAN	
Thousand Lakes	LAVO		Superstition	SUPE	SUPW
Caribou	LAVO		Galiuro	GALI	
Yolla-Bolly-Middle Eel	YOBO		Chiricahua	CHIR	
Desolation	BLIS		Gila	GILA	
Mokelumne	MOKE		White Mountain		
Emigrant	EMIG		Pecos		
Hoover	HOOV		San Pedro Parks	SAPP	SAPE
Ansel Adams	ANAD		Wheeler Peak	WHPE	WHPL
Kaiser			Caney Creek	CACR	
John Muir	JOMU		Upper Buffalo	UPBU	
Ventana	VENT		Hercules-Glades	HEGL	
Dome Land	DOLA		Boundary Waters Canoe Area	BWCA	
San Rafael	SARA		Rainbow Lake		
Cucamonga			Great Gulf	GRGU	
San Gabriel	SAGA		Presidential Range - Dry River	GRGU	
San Gorgonio	SAGO		Lye Brook	LYBP	
San Jacinto			Dolly Sods	DOSO	
Agua Tibia			Otter Creek	DOSO	
Jarbidge	JARB		James River Face	JARI	
Sawtooth	SAWT		Linville Gorge	LIGO	
Selway-Bitterroot	HEHA		Joyce Kilmer - Slickrock	JOKI	
Anaconda-Pintler	SULA		Shining Rock	SHRO	
Gates-of-the-Mountain			Cohutta	COHU	
Scapegoat	BOMS		Sipsey	SIPS	
Mission Mountains			Bradwell Bay		
Bob Marshall	BOMN	BOMS			
Cabinet Mountains	CAMT				

Visibility Monitoring Sites

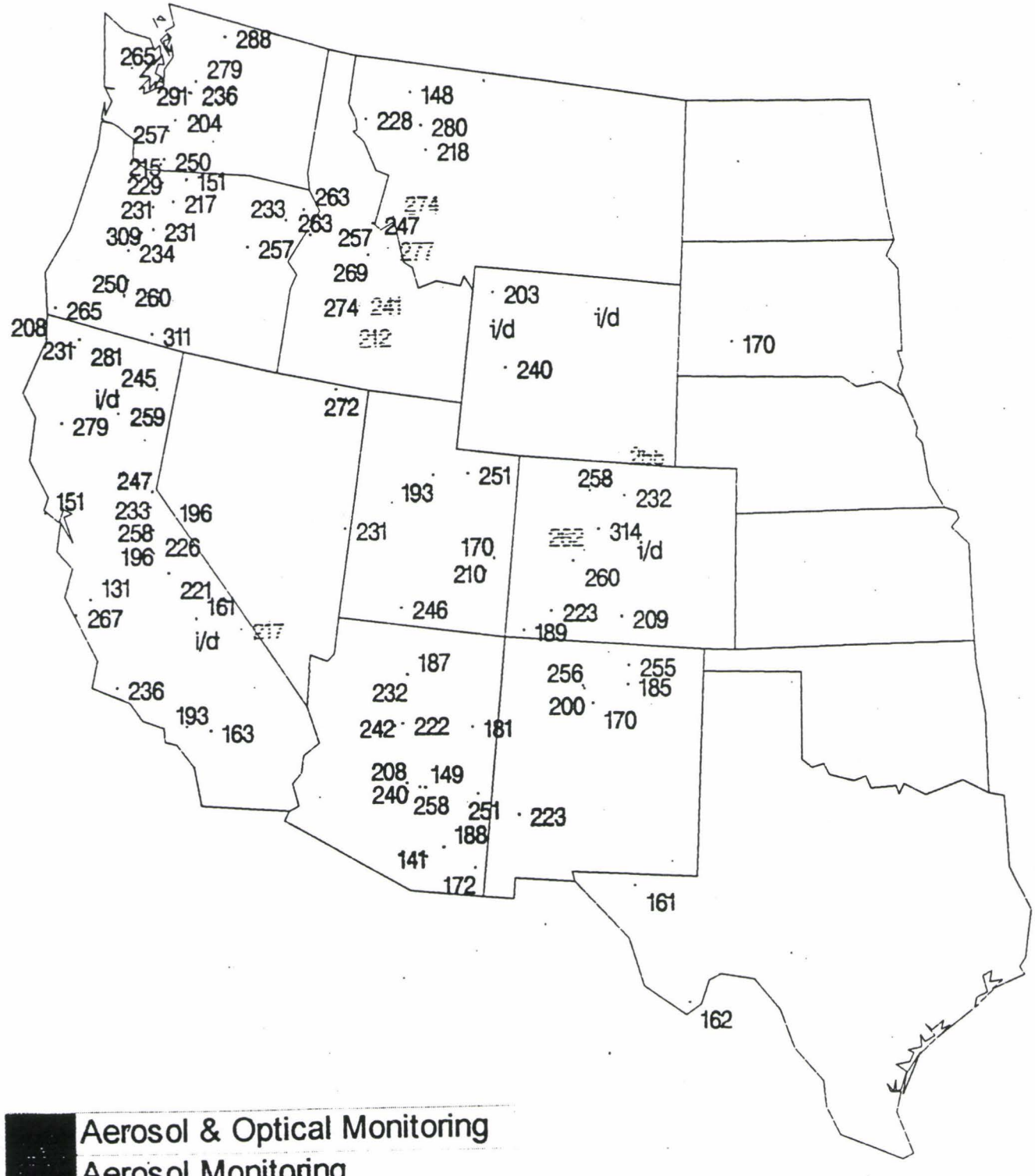
All Sites – Western States



- Aerosol & Optical Monitoring
- Aerosol Monitoring
- Partial Aerosol Monitoring
- Scene Monitoring

90th Percentile Annual Standard Visual Range (km)

All Sites – Western States



Aerosol & Optical Monitoring

Aerosol Monitoring

Partial Aerosol Monitoring

Scene Monitoring

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Research Paper USFS

By Dr Roger Ottmar et al

dated 11/27/96

Paper concerns the wildfire/Rx fit. Tradeoffs - states "smoke loads from wildfire 2 to 4 times greater than Rx fire"

—— Useful data for Rx fire NEPA evaluations ——

I

AIR/SMOKE Monitoring Requirements

Air Resource Monitoring Requirements

I

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Region 8

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Region 4

The Air Resource Management (ARM) program is relatively new to the Forest Service. Air as a resource is difficult from a forest management perspective to manage, especially since it is a resource that managers have received very little, if any, training in its behavior and management requirements. The difficulty is compounded by the fact that we are emitters and recipients of air pollution.

The quality of air affects the health of all other forest resources and the type of experiences by Forest visitors. An effective ARM program requires an interdisciplinary (ID) approach in its planning, implementation and monitoring. At the Forest level, the ID Team will use Washington Office and Regional Office direction and guidance to design and implement the monitoring of Air Quality Related Values (AQRV). The Chief, in his framework for the Air Resource Management (ARM) program, recognized the dynamics of the air resource, its management and its interdisciplinary requirements (see Exhibit 1).

This presentation provides generic monitoring for air resource and discusses the relationship between the Chief's framework and monitoring types to meet National Forest Management Act monitoring requirements (see Exhibit 2).

MONITORING RELATIONSHIPS

The following examples are not all-inclusive but are for illustration.

Monitoring Class I Areas

The purpose for monitoring Class I areas is to determine our progress in following the Chief's strategy for Class I areas.

1. **Implementation** monitoring answers the question, "How well did we do in reviewing Prevention of Significant Deterioration (PSD) permits?" The unit of measure should include promptness, professional review, meaningful response, etc., such as indepth review documented by written response completed within 30 days of receipt of notice from the state.

2. **Effectiveness** monitoring would answer the question, "Did our recommendations make a difference in the State's decision for issuing the permits?" The units of measure could be the percentage of Federal Land Managers' (FLM) recommendations used by the State.

3. **Validation** monitoring could answer the question, "How appropriate is the technology we are using to evaluate PSD permits?" This includes improving coefficients used in transport and deposition models.

4. **Trend** monitoring would answer the question, "Are air pollution and its effects improving or getting worse?" This would include analyzing data from visibility monitoring sites.

Monitoring Class II Areas

The purpose for monitoring Class II areas is to measure forest health by the accumulation of current conditions for individual resources that can be affected by air pollution.

1. **Implementation** monitoring would answer the questions, "Did we accomplish the needed measurements for Forest Health?" or "Did we implement the terms of Memorandums of Understandings (MOU's) with State Air Regulatory Agencies?"

2. **Effectiveness** monitoring answers the question, "Are air quality mitigation measures adequate for assuring progress in maintaining forest health?" These measures would include coordination with State Air Regulatory Agencies and how effective this involvement has been in reducing adverse air pollution impacts or minimizing unnecessary regulation of forestry practices by the air regulatory agencies.

3. **Validation** monitoring would answer the question, "Are techniques for defining, measuring and predicting improvements of forest health appropriate?"

4. **Trend** monitoring would be used to complete periodic emission inventories, to determine rates of increment consumption and to relate these to trends in forest health and to the attainment of the national goal for reducing emissions and their adverse effects.

Monitoring NFS Sources

The purpose for monitoring NFS sources is to protect public health and safety and to assure compliance with Federal and State air quality standards and regulations.

1. **Implementation** monitoring would answer the question, "Have prescribed burning plans been properly made and executed? Have the incidents of smoke intrusion been limited to only wildfire situations?"

2. **Effectiveness** monitoring would answer the question, "Have smoke management techniques or mitigation measures kept smoke from prescribed burning from causing any intrusions? How much have these techniques or mitigation measures reduced emissions per acre compared to the 1980 base year?"

3. **Validation** monitoring would answer the question, "How can techniques or mitigation measures for attaining a reduction in emissions be improved?"

The design of the monitoring effort needs to be specific in terms of: objectives, what, when, where, how often, desired precision and reliability (36 CFR 219.12(k)(4)(ii)). Include specific Quality Assurance/Quality Control (QA/QC) procedures for data collection, analysis, interpretation and reporting, including who prepares the report and who receives the report. In addition, a safety plan may be needed.

Monitoring of ambient air quality may be needed to determine whether or not a AQRV or forest health is affected by air quality. In addition, we will need to monitor for trends in air pollution and resource effects.

Exhibit 1

Framework for the Forest Service Air Resource Management Program

Purpose

Show strategies for the Forest Service Air Program to strengthen internal coordination and help others understand different components. Provide Regions and Forests with framework for developing programs, budgets and priorities.

Program Objectives

1. **Protect 88 Class I wilderness areas:**

   Strategy

   a. Identify air quality related values (AQRV's).

   b. Establish screening procedures via regional workshops.

   c. Establish current condition of AQRV's.

   d. Monitor AQRV's for change.

   e. Establish and maintain liaison with regulatory agencies as early warning system for proposed industrial activities.

   f. Prepare recommendations to the regulatory agencies on New Source Review (PSD) permit applications.

   g. Train specialists and managers in operational and management methods.

   h. Quantify effects of air pollution on ecosystem components.

2. **Protect forest and grassland resources**

   Strategy

   a. Determine locations for high pollutant concentrations and areas of probable adverse effects using existing emission data, air quality monitoring, personal observation, modeling, and professional consultation.

   b. Determine current condition of forest and grassland resources in these areas.

   c. Establish monitoring sites throughout forest and grassland areas.

d. Orient air regulatory personnel with condition, trends, and significance of findings.

e. Train specialists and managers on operations and management methods:

(1) Provide field with training courses and material.

(2) Establish short courses via universities or other Federal agencies on New Source Review (PSD), monitoring, modeling, and technical ARM orientation.

3. **Minimize impacts of forestry activities on air quality.**

Strategy

a. Reduce emissions and mitigate smoke impacts from prescribed burning.

(1) Require practitioners to use improved smoke management methods.

(2) Develop improved burning techniques with related effectiveness and emission factors.

(3) Educate key publics and air regulators about the advantages and drawbacks of prescribed fire.

b. Require air quality standards and guides in Land Management Planning and in project work plans, where appropriate, such as prescribed burning plans.

c. Incorporate performance requirements concerning air quality in special use permits for minerals, oil, gas, ski areas, and other developments on National Forest lands that would affect air quality.

Exhibit 2

Monitoring Relationship (36 CFR 219.27(a)(12),(b)(5); 36 CFR 219.12(k)(2))

Chief's Framework	Monitoring Type	Examples
Class I	Implementation Effectiveness Validation Trend	PSD Review Make a Difference Appropriate Technology Visibility, Increment
Class II	Implementation Effectiveness Validation Trend	Measurements S&G's Technology Increment, Emissions
NFS Sources	Implementation Effectiveness Validation	Smoke Management Guides Reduction of Emissions Techniques